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053 0534

Water Solutions, Inc.

Transmittal

To:	Ravi Sanga	From:	Peter Pellegrin
Address:	EPA Remedial Project Manager U.S. EPA Region 10 1200 Sixth Avenue, ECL 111 Seattle, WA 98101	Date:	April 9, 2018
Re:	FMA GETS Modifications		

Attachments **For Review** **Please Comment** X **For Your Use**

Date	Number of Copies	Description
March 2018	3	FMA GETS Modifications (with CD)

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March 30, 2018

Mr. Ravi Sanga
EPA Remedial Project Manager
U.S. EPA Region 10
1200 Sixth Avenue, ECL 111
Seattle, Washington 98101

RE: Feed Makeup Area Groundwater Extraction System - Operational Modifications to Accelerate Attainment of Cleanup Levels at EW-2 and PW-28A

Dear Mr. Sanga:

Please find enclosed three (3) copies of the *Feed Makeup Area Groundwater Extraction System - Operational Modifications to Accelerate Attainment of Cleanup Levels at EW-2 and PW-28A.* An electronic version of the report is also included.

If you have any questions, please feel free to contact me at (541) 926-4211 x.6365.

Sincerely,

Noel Mak
NPL Program Coordinator

Enclosures: 1. *Feed Makeup Area Groundwater Extraction System - Operational Modifications to Accelerate Attainment of Cleanup Levels at EW-2 and PW-28A*

GSI
Water Solutions, Inc.

To: Noel Mak/ATI Metals

From: Peter Pellegrin/GSI Water Solutions, Inc.
Dave Livesay, RG/GSI Water Solutions, Inc.
Matt Kohlbecker, RG/GSI Water Solutions, Inc.

Date: March 30, 2018

Re: **Feed Makeup Area Groundwater Extraction System – Operational Modifications to Accelerate Attainment of Cleanup Levels at EW-2 and PW-28A**

Introduction

This technical memorandum (TM) describes modifications to the operation of the groundwater extraction system (GETS) in the Feed Makeup Area (FMA) of the ATI Millersburg, Oregon, facility. The goals of the operational changes to the GETS are to: (1) accelerate the reduction of the combined concentration of radium-226 and radium-228 in two wells, EW-2 and PW-28A, which remain above the Record of Decision (ROD; EPA, 1994) cleanup level for these compounds, and (2) raise the source area pH, particularly in PW-28A (see Figure 1). The modifications were developed in accordance with the *Feed Makeup Area Groundwater Extraction System – Proposed Operational Modifications to Accelerate Attainment of Cleanup Levels at EW-2 and PW-28A; Revised Final* (Work Plan; GSI, 2017) which was approved by EPA in June 2017.

System modifications are based on hydraulic testing and will be implemented in two phases. Phase 1, which begins on April 2, 2018, consists of continuous pumping groundwater at EW-2 (EW-1 and EW-3 will remain idle) for 6 months and conducting quarterly groundwater monitoring to assess the outcome and effectiveness of the operational modification. Phase 2 consists of pulse pumping at EW-2 for another 6 months from approximately October 2018 to April 2019. During this period quarterly groundwater monitoring will also be conducted.

This Work Plan identifies two deliverables. The first deliverable is this TM, which provides details about technical evaluations performed to develop the system modifications. It describes preliminary well inspections and development, pump modifications, and the results of hydraulic testing. The second deliverable will provide an evaluation of Phase 1 and Phase 2 operations using the quarterly performance monitoring data. It is anticipated that document will be submitted to EPA in July 2019.

Updated Current Conditions – pH and Combined Radium-226 and Radium-228

The Work Plan provided analytical data for pH and combined radium for a 5-year period, ending in May 2016. This data set and supporting tables and figures have been updated in this TM to include the more recent results derived from biannual groundwater monitoring in the fall of 2016 and in the spring and fall of 2017. The groundwater monitoring and remediation network in the FMA consists of eight monitoring wells and three extraction wells, which are divided into background wells and source area wells.

Background Wells

The background wells are:

- PW-22A
- PW-23A
- PW-24A
- PW-27A

Radium isotopes in background wells historically have remained below the combined ROD cleanup level of 5 picocuries per liter (pCi/L) for radium-226 and radium-228. In the most recent 5-year groundwater monitoring period, none of the background wells exceeded the ROD cleanup level for combined radium (see Figure 2). Measurements for pH continue to be acceptable at wells PW-22A and PW-23A, however wells PW-27A and PW-24A have historically been slightly below the acceptable pH range of 6.5 to 8.5 (see Figure 3).

Source Area Wells

The source area wells are listed below. Each extraction well is listed with the closest associated monitoring well(s):

- EW-3 – PW-50A
- EW-2 – PW-28A
- EW-1 – PW-51A and PW-52A

The combined radium concentrations in source area wells for the past 5-year period are presented in Figure 4. Since May 2016, groundwater from extraction wells EW-3 and EW-1, and their associated monitoring wells, have remained below the ROD cleanup level for combined radium. EW-2 (24 pCi/L) and PW-28A (36 pCi/L) are the only two wells in September 2017 that have concentrations above the cleanup level of 5 pCi/L. Groundwater samples in the fall of 2017 were collected after EW-1 and EW-3 had been shut off for 35 days during completion of hydraulic tests at EW-2. No discernable effect of the shutdown could be observed in the associated groundwater data.

Groundwater pH in source area wells historically has been acidic and below the ROD cleanup level of between 6.5 and 8.5. The only source area well consistently within the ROD-specified range for pH is PW-51A, which had a pH of 6.61 in May 2016 and 6.26 in September 2017. Figure 5 shows the pH recorded in all source area wells in the past 5 years. The pH and radium data for FMA background and source area wells are presented in Table 1.

Figure 6 compares the most recent data from September 2017 to data from May 2016. There was a slight downward trend in combined radium concentrations since May 2016 in the background wells and no clear trend in the FMA source area wells which is one reason why ATI wishes to make modifications to improve the performance of the GETS.

Preliminary Activities

Before initiating hydraulic tests and subsequent operational modifications in the FMA, ATI completed a number of tasks to optimize the performance of the GETS, including extraction well inspection, development, and maintenance.

Extraction Well Inspection

ATI removed the pumps from the three FMA extraction wells on June 28, 2017, to inspect the condition of the wells (see Attachment B for FMA well log details). Brett Jones of Jones Drilling, Sweet Home, Oregon, completed the well video surveys. No breaks or structural damage to the polyvinyl chloride (PVC) spiral-wrapped well screens were observed in the wells. In general, the well screens were free of significant growths with the exception of some orange slime at approximately 27 to 25 feet below ground surface (bgs).

At the time of the survey, it was thought that the existing pumps in EW-3 and EW-2 had recently failed because the flow meters recorded zero flow. Therefore, ATI ordered new pumps (see the "Extraction Well Maintenance" section for additional information on the new pumps). Water levels recorded before and after the well surveys and during the baseline sampling on April 6, 2017, however, indicated that the existing pumps had not failed because the water levels rose in the wells after the pumps were shut off at the control panel. Specifically, in the 20-hour period between pump removal and well development, the water levels in the extraction wells rose an average of 6.18 feet. During subsequent maintenance, the existing pumps were found to be operational, but the impellers in the flow meters were jammed and thus not recording the volume of groundwater being extracted from the wells.

Extraction Well Development

Cascade Drilling (Cascade) completed well development on June 29, 2018. Cascade fabricated well-specific brushes and surge blocks for the 4-inch-diameter wells and brushed, bailed, surged, bailed, and pumped each well to remove debris. The final phase of development was accomplished with a submersible pump that was moved along the well screen and the bottom of each 3-foot-deep sump until the discharge water was clear. No issues were encountered during well development.

Extraction Well Maintenance

ATI undertook a number of measures to improve the performance of the GETS before beginning hydraulic testing in the well network. New pumps with greater resistance to acids and lower actuation points were installed in EW-1, EW-2, and EW-3 (QED AP4+ Ultra). The pump design creates a lower pumping level and the pumps were positioned approximately 5 feet deeper in the wells to increase drawdown and groundwater capture.

During installation of the new pumps, the discharge and pneumatic lines within the wells were replaced and the system discharge lines at each well were flushed with approximately 1,500 gallons of fresh water. The plumbing was inspected and serviced, as needed, and the flow meters were disassembled and cleaned. Future work will service or replace the backflow preventers and reduce the diameter of some sections of the discharge pipes for greater pump efficiency.

Table 2 provides additional details on the new pumps and their placement in the FMA extraction wells. While ATI has taken steps to increase pumping performance, the limiting factor to extraction well yield in the FMA will continue to be the relatively low hydraulic conductivity of the soils (CH2M, 2002).

Transducer Installations

In-Situ LevelScout non-vented pressure transducers were installed in all the FMA source area wells before beginning hydraulic testing on August 19, 2017. A barometric transducer was installed in the nearby pump control panel to provide for the correction of all collected data. A laptop was used to examine real-time data in the field to determine when water levels had stabilized and a given test could be stopped or started.

There were no performance issues with the transducers. New temporary caps were fabricated for hanging the transducers in the wells and steps were taken to prevent stormwater runoff from entering the wells during the tests (the extraction wells have flush-mount completions). No major precipitation events occurred during the testing that interfered with the analysis of the data.

Hydraulic Test Methods

Hydraulic testing in the FMA took place between August 19 and October 17, 2017, according to the specifications provided in the Work Plan. Table 3 provides a summary of the project activities and completion dates, including the dates of the hydraulic tests.

Transducers deployed in the FMA source area wells were used to record water levels during the following pump cycles:

- **Test 1:** Drawdown and recovery, pumping at EW-1, EW-2, and EW-3
- **Test 2:** Drawdown and recovery, pumping at EW-2 alone
- **Test 3:** Drawdown, pumping at EW-1 and EW-3

To compliment transducer data, xanthene tracer dye (BrightDyes™) was employed during the hydraulic tests to provide additional information about groundwater velocities between the project wells. According to the manufacturer, 16 ounces of dye used in approximately 12,500 gallons of water provides a strong visual detection, and 16 ounces of dye used in 125,000 gallons of water provides a light visual detection. On average, approximately 10 ounces of orange, yellow, blue, or green dye were added directly to project wells during the pump tests.

Unfortunately, dye was never observed in the extraction wells during the pump tests. The main reason for this was the rapid equilibration of water levels in the monitoring wells during the tests, which resulted in relatively short pumping durations. In Test 1, the pumps were operated for 76 hours at an average rate of approximately 0.5 gpm. This rate and duration did not result in a large enough volume of extracted groundwater to expect to see dye between wells, even at relatively short distances from each other. In Test 2, the pumping duration was much longer, 192 hours, but the distance between the extraction wells (55 feet), where dye was employed, was greater as well. Again, the pumping duration was too short, considering the volume of groundwater over that distance, to allow for visual observation of dyes. Future dye tests will be completed that make use of greater concentrations of dye and longer pumping durations.

Test 1 Methods: Pumping at EW-1, EW-2, and EW-3

No pumping occurred in the FMA for 1 week before beginning Test 1 to allow groundwater levels to recover to static conditions[1]. On August 19, 2017, pumping began at extraction wells EW-1, EW-2, and EW-3. The extraction wells were pumped continuously for approximately 3 days (76 hours) at an average pumping rate of 0.35 gpm at EW-1, 0.41 gpm at EW-2, and 0.74 gpm at EW-3. Following pumping, water levels were allowed to recover for about two weeks.

Test 2 Methods: Pumping at EW-2 Alone

No pumping occurred in the FMA for two weeks before Test 2 to allow groundwater levels to recover to static conditions following Test 1. When static conditions were confirmed, pumping began at extraction well EW-2 on September 5, 2017. This well was pumped for 8 days, followed by a recovery period of 13 days. The average pumping rate at EW-2 during the test was 0.45 gpm.

Test 3 Methods: Pumping at EW-1 and EW-3

No pumping occurred in the FMA for 16 days before Test 3 to allow groundwater levels to recover to static conditions following Test 2. On September 29, 2017, pumping began at extraction wells EW-1 and EW-3. The two wells were pumped simultaneously for 19 days. The average pumping rates at EW-1 ranged from 0.30 to 0.44 gpm, and the average pumping rate of EW-3 ranged from 0.58 to 0.65 gpm.

Test 3 was designed to provide data for potential implementation of alternate pumping schedules (see Phase 3 below). Data from Test 3 will be examined in more detail if Phase 1 and Phase 2 operational modifications implemented in 2018 prove to be inadequate in meeting cleanup objectives in the FMA.

Hydraulic Test Results

Groundwater elevations under pumping and non-pumping conditions were measured, plotted, and contoured to empirically determine the groundwater response to pumping in the FMA. Static groundwater elevations were measured with an electronic tape. Groundwater elevations during pumping were measured with downhole pressure transducers. The data were used to generate individual well hydrographs for each test, and groundwater elevation contours under three scenarios: (1) static (no pumping) groundwater elevations; (2) groundwater elevations with EW-1, EW-2, and EW-3 pumping; and (3) groundwater elevations with EW-2 pumping alone.

Under pumping scenarios, the groundwater elevation contours at extraction wells were corrected for turbulent well losses by calculating a well efficiency for the extraction wells, and multiplying the observed drawdown by the well efficiency (which reduces the observed drawdown at the well)[2]. The corrected drawdown represents drawdown in the aquifer outside of the well.

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[1] During this time, pumps were replaced and the GETS components were serviced. Short-term (1-hour) testing of each new pump occurred at least 2 days before Test 1 began.

[2] The well efficiency was calculated using a distance-drawdown plot from the EW-2 pumping test. Well efficiency at EW-2 was calculated by dividing theoretical drawdown by observed drawdown in EW-2. The well efficiency analysis was verified by comparing transmissivity calculated from the distance-drawdown plot during the EW-2 pumping test to transmissivity calculated from a time-drawdown plot during the EW-2 pumping test; the distance-drawdown transmissivity (110.5 gpd/ft) agreed well with the time-drawdown transmissivity (107 gpd/ft at PW-28A). We assumed that the well efficiencies for EW-1 and EW-3 were the same as the well efficiency for EW-2.

Under pumping scenarios, the groundwater elevation contours were used to estimate capture zones for each extraction well. The capture zones were estimated by first drawing flow paths perpendicular to the groundwater contours, and then by drawing a capture zone around the flow paths. This is only an approximation but it is adequate for this evaluation.

Static Groundwater Elevations

Figure 7 presents the groundwater elevation contours after a 13-day period of non-pumping from water levels measured on September 26, 2017 (see Table 4). The contours confirm the southwest flow direction presented in the annual remedial progress summaries for the Extraction Area and identify a northwest-southeast trending groundwater divide under non-pumping conditions that runs roughly through extraction wells EW-1 and EW-2. Contouring completed in 1997 and 1998 before the installation of the GETS in 2002 identified a groundwater divide in the same location. Under non-pumping conditions, water flows northeast from EW-2 toward PW-28A and Pond 1B. This difference in groundwater flow direction from routine pumping conditions was used in developing the pulse pumping schedule for the Phase 2 modifications discussed in the section on operational modifications below. In addition, the groundwater divide informed the methodology for determining capture zones[3].

Test 1 Results: EW-1, EW-2, and EW-3 Pumping

Figure 8 presents the hydrograph for Test 1. Maximum drawdown at each extraction well was about 15 feet, and occurred within 1 hour of turning on the pumps. While the new replacement pumps are designed to produce approximately 13 gpm, the limiting factor in extraction rates is the low hydraulic conductivity in the FMA subsurface which limits flow toward the wells. Water levels fell in all of the monitoring wells during the 76 hours of pumping with drawdowns ranging from 0.8 foot (PW-51A) to 1.9 feet (PW-28A) (see Figure 9).

The capture zone created by pumping EW-1, EW-2, and EW-3 is approximated spatially in Figure 10. This approximation shows that capture throughout the FMA is achieved and groundwater with constituents that exceed ROD cleanup levels for combined radium (i.e., EW-2 and PW-28A) is captured along with groundwater with constituents that do not exceed ROD cleanup levels for radium (i.e., EW-3, PW-50A, EW-1, and PW-52A).

Test 2 Results: EW-2 Only Pumping

Figure 11 presents the hydrograph for Test 2. Maximum drawdown at EW-2 was about 15 feet, and occurred within 1 hour of turning on the pump. As expected, the response to pumping in the monitoring wells was significantly less than pumping all three wells simultaneously (Test 1) however water levels fell in all of the monitoring wells during the 8 days of pumping with drawdowns ranging from 0.1 foot (PW-51A and PW-52A) to 1.4 feet (PW-28A) (see Figure 12).

A noteworthy finding from Test 2 is that the hydraulic gradient between PW-28A and EW-2 is about 4 percent greater when only EW-2 is extracting groundwater (0.205 foot per foot [ft/ft] when all wells pump as compared to 0.213 ft/ft when only EW-2 pumps). This is because when EW-1 and EW-3 are also operating, as in Test 1, they draw down the water level somewhat in PW-28A, which flattens the gradient. The flushing rate of groundwater through contaminated soils nearby PW-28A, therefore, is slightly enhanced when EW-2 is operated alone.

[3] Specifically, capture zones were delineated using direct observation of drawdowns during pumping, as opposed to an analytical model (e.g., WinFlow). WinFlow cannot be used to delineate capture zones in areas with a groundwater divide because WinFlow assumes a unidirectional, constant horizontal gradient.

The capture zone created by pumping EW-2 alone is shown in the Test 2 hydrograph and presented spatially in Figure 13. As expected, EW-2 pumping alone captures all groundwater with constituents that exceed ROD cleanup levels for combined radium (i.e., EW-2 and PW-28A). EW-2 pumping alone does not capture as much groundwater that is below ROD cleanup levels for combined radium (i.e., note that the capture zone in Figure 13 is smaller than the capture zone in Figure 10).

Test 3 Results: EW-1 and EW-3 Pumping

Figure 14 presents the hydrograph for Test 3. Maximum drawdowns at EW-1 and EW-3 were about 14 feet, and occurred within 1 hour of turning on the pump. Water levels fell in all of the monitoring wells during the 19 days of pumping with drawdowns ranging from 0.3 (EW-3) to 0.9 feet (PW-52A and PW-51A).

At the end of the drawdown test, EW-2 was turned back on pending analysis of the three hydraulic tests. No operational modifications were put in place before analyzing the pump test data. Beginning on October 17, 2017, all three extraction wells were put back into routine service.

Extraction System Operational Modifications

Preliminary Considerations

The Work Plan outlined a number of potential operational modifications to optimize the performance of the GETS remedy in the FMA. These options are ordered into sequential phases in the list below. If a particular phase is successful in meeting project objectives, it will not be necessary to implement additional phases:

- **Phase 1:** Extraction through EW-2 alone
- **Phase 2:** Pulse pumping of EW-2
- **Phase 3:** Alternate pumping of extraction wells
- **Phase 4:** Water-flushing or buffered injection into EW-1 and EW-3 while extracting from EW-2
- **Phase 5:** Water flushing or buffered injection into injection points installed in the PW-28A area after consultation with EPA

Phase 1: Extracting at EW-2 Alone

The results indicate that it is not necessary to pump all three extraction wells to hydraulically control groundwater that exceed ROD cleanup levels for combined radium (PW-28A). Pumping at EW-2 alone focuses hydraulic capture on the groundwater that is most contaminated and therefore is the most efficient method of reducing combined radium concentrations and raising groundwater pH in EW-2 and PW-28A.

An added benefit of pumping EW-2 alone is that the wetting-out and flushing of groundwater through contaminated soils may be increased when only EW-2 is operated. As discussed in the section on Test 2 above, the groundwater elevation at PW-28A is higher when only EW-2 is extracting than when all of the extraction wells are in operation. This is because EW-1 and EW-3 drawdown the groundwater level at PW-28A. In addition, the extraction rate at EW-2 is higher when the other extraction wells are turned off (0.04 gpm, or approximately 21,000 gallons per year).

Phase 2: Pulse Pumping at EW-2

Section 10.1.1.2 of the ROD recognizes that in addition to discontinuing pumping where cleanup levels have been attained (Phase 1), there is value in pulse pumping of extraction wells to minimize stagnation and to provide an opportunity for contaminants to partition to groundwater. Phase 2 pumping will involve pulse pumping at EW-2 according to schedules derived from the data obtained from the hydraulic testing that have then been amended to meet ATI staffing constraints. The GETS controls are manual valves and switches that require the active participation by ATI personnel to turn off or turn on pumps.

The pulse pumping schedule is based on the following observations during Test 2 (EW-2 pumping alone):

- The well reached total drawdown approximately 9 minutes after the well began pumping. Drawdown recorded after 9 minutes was 15.14 feet, while after 192 hours of pumping the drawdown was essentially the same (15.07 feet).
- When EW-2 is shut off, it takes approximately 4 hours for the groundwater elevation in EW-2 to rise above the elevation recorded in PW-28A (see Test 2 hydrograph, Figure 11). Therefore, after 4 hours, the groundwater gradient in the FMA begins to shift from southwest to northeast flow. This change of flow direction was identified in the groundwater elevation contouring of ambient conditions in the FMA in the absence of any extraction pumping (see Figure 7).
- In Test 2 the drawdown recorded in PW-28A after 16 hours of pumping at EW-2 was 68 percent of the total drawdown recorded during the test[4] (see Figure 11).
- ATI environmental personnel routinely work in the FMA during daylight hours when pump valve and switch adjustments can be completed.

Phase 2 pulse pumping at EW-2 will be initiated after Phase 1 testing is complete. ATI environmental personnel who are at the site each day will accomplish the manual switching off and on of EW-2. The pump will be shut off for approximately 8 hours per day (eg, 8 a.m. to 4 p.m.) and set to run for 16 hours a day (eg, 4 p.m. to 8 a.m.).

This pulse pumping schedule will result in the same drawdown in extraction well EW-2, and will result in similar drawdown in PW-28A (about 68% of the drawdown from continuous operation of EW-2). The pulse pumping schedule for EW-2 will provide a 4-hour period when the groundwater at PW-28A will flow to the northeast and away from EW-2 (during the first 4 hours of the 8-hour scheduled shut off cycle, the groundwater gradient is still toward the extraction well). This will provide an opportunity to reduce stagnation at PW-28A and capture adsorbed contaminants outside the range of current pumping practices. There will be some inefficiency in contaminant mass removal as groundwater moves away from the extraction well, but this water will be captured in the extending pumping period, which is twice as long as the non-pumping period.

Initial Operational Modifications

Since the completion of the hydraulic testing on October 17, 2017, ATI has been operating EW-1, EW-2, and EW-3. On April 2, 2018, ATI will begin Phase 1 of the operational modifications in the FMA by switching off EW-1 and EW-3 to operate EW-2 alone.

[4] Drawdown in PW-28A after 16 hours of pumping EW-2 was 0.932 feet; drawdown in PW-28 after 8 days of pumping EW-2 was 1.362 feet.

Pump tests, transducer data, and analytical data collected in 2017 support implementing Phase 1 modifications because pumping EW-2 alone will increase the flushing rate and the capture by the GETS that is comprised of a higher percentage of groundwater above ROD standards. Phase 2 modifications have the potential to capture contaminants that have been outside the range of current pumping operations and thus reduce the time required to attain cleanup levels for combined radium in EW-2 and PW-28A.

Data gathered during the Phase 1 and Phase 2 operational modifications will show if these pumping schedules are more effective at capturing groundwater zones with higher concentrations of contaminants than operation of all three extraction wells.

Phase 1 pumping will take place over a period of approximately 6 months from April to October 2018. Phase 2 pulse pumping will be completed for an additional 6-month period from October 2018 to April 2019.

Phases 3 through 5 Operational Modifications

Concurrent to the implementation of Phase 1 and Phase 2 operational modifications, groundwater data will be collected quarterly and used to assess the effectiveness of the modifications. If groundwater results are not favorable, ATI will provide additional details and implement additional modifications to ensure project cleanup goals are met. These details will be provided in a TM submitted to EPA with the results of the quarterly monitoring.

Schedule

ATI will begin implementation of Phase 1 modifications, pumping at EW-2 alone, after collecting baseline analytical samples on April 2, 2018. The first quarterly groundwater sampling event for the project is scheduled to take place in late May 2018. Phase 1 will proceed for approximately 6 months, or until October 2018. At that time, Phase 2, pulse pumping of EW-2, will begin. The extraction well will be run for 16 hours a day and shut off for 8 hours a day for an additional 6-month period through April 2019. The project schedule is presented in Table 3.

Reporting and Performance Monitoring

In the Work Plan, ATI said it would evaluate strategies for enhancing mass removal of radium through operation of EW-2 alone and alternate and/or pulse pumping of the extraction wells. Data from the hydraulic testing indicate these modifications have potential to meet project cleanup goals. Phase 1 and Phase 2 operational modifications will test the effectiveness of these two strategies over the course of the next year.

In the Work Plan, ATI also agreed to initiate quarterly groundwater monitoring after operational modifications to the GETS had been made. Phase 1 modifications were implemented on April 2, 2018, and the first quarterly monitoring event will be completed in late May 2018. Phase 2 modifications will be tested through early April 2019. The dates of the quarterly groundwater monitoring events are presented in Table 3.

ATI will provide EPA with a TM containing the results from the quarterly performance monitoring to assist EPA in evaluating the effectiveness of the GETS modifications in July 2019. That TM will discuss the potential for long-term implementation of the Phase 1 and Phase 2 modifications or the need to initiate additional phases of operational modifications, such as alternate pumping at all of the extraction wells or injection of water or buffered injections in the EW-2, PW-28A area.

References

CH2M HILL. 2002. Feed Makeup Area Construction Report. Prepared for Wah Chang, July 2002.

EPA. 1994. Record of Decision, Declaration, Decision Summary, and Responsiveness Summary for Final Remedial Action of Groundwater and Sediments Operable Unit, Teledyne Wah Chang Albany Superfund Site, Millersburg, Albany. June 10, 1994. U.S. Environmental Protection Agency, Region 10.

EPA. 2015. US EPA Comments – Feed Makeup Area Groundwater Soil Flushing Project and Performance Summary, Extraction Area, Groundwater and Sediments OU 2, Teledyne Wah Chang Superfund Site, Albany, Oregon. Comment 5, page 2: "The need for a second round of injections must be considered in the area of wells with continuing low pH measurements (PW-28A, PW-50A, PW-52A, and EW-2).

GSI. 2015. Feed Makeup Area Groundwater Soil Flushing Project and Performance Summary, Extraction Area, ATI Wah Chang Facility, Albany, Oregon.

GSI. 2016. Extraction Area Groundwater Year 2015 Remedial Action Progress Summary. November 2, 2016.

GSI. 2017. Feed Makeup Area Groundwater Extraction System – Proposed Operational Modifications to Accelerate Attainment of Cleanup Levels at EW-2 and PW-28A; *Revised Final.* June 12, 2017.

Attachment A. Feed Makeup Area Background Reports

- *South Extraction Area 1st Annual Monitoring Report (October 2000 through November 2001)* (CH2M HILL, December 10, 2001)
- *Extraction Area Remedial Action Progress Report – November 2001 through April 2002* (CH2M HILL, June 10, 2002)
- *Extraction Area Remedial Action Progress Report – May to December 2002* (CH2M HILL, February 7, 2003)
- *Extraction Area Remedial Action Progress Report – January to June 2003* (CH2M HILL, August 21, 2003)
- *Extraction Area Remedial Action Progress Report – July to December 2003* (CH2M HILL, February 2004)
- *Extraction Area Groundwater Year 2004 Remedial Action Progress Summary* (CH2M HILL, March 2005)
- *Wah Chang Extraction Area Groundwater Remedy 3-Year Evaluation* (CH2M HILL, September 2007)
- *Extraction Area Groundwater Year 2007 Remedial Action Progress Summary* (CH2M HILL, September 30, 2008)
- *Extraction Area Groundwater Year 2008 Remedial Action Progress Summary* (2008 annual report; GSI Water Solutions, Inc., March 12, 2009)
- *EISB Pilot Test Procedures and Initial Performance Summary, South Extraction Area, ATI Wah Chang Facility, Albany, Oregon,* (2009 SEA TM; GSI Water Solutions, Inc., March 26, 2009)
- *Extraction Area Groundwater Year 2009 Remedial Action Progress Summary* (2009 annual report; GSI Water Solutions, Inc., April 1, 2010)
- *EISB Pilot Test Summary, South Extraction Area, ATI Wah Chang Facility, Albany, Oregon* (2011 SEA TM; GSI Water Solutions, Inc., August 16, 2011)
- *Extraction Area Groundwater Year 2010 Remedial Action Progress Summary* (2010 annual report; GSI Water Solutions, Inc., August 15, 2011) (Revised with Response to EPA Comments dated June 3, 2011)
- *Feed Makeup Area – Second Lake Groundwater pH Sampling Transect Results* (2011 FMA TM; GSI Water Solutions, Inc., October 26, 2011)
- *Extraction Area Groundwater Year 2011 Remedial Action Progress Summary* (2011 annual report; GSI Water Solutions, Inc., September 5, 2012)
- *Feed Makeup Area Groundwater Focused Feasibility Study and Treatability Study Work Plan* (2013 work plan; GSI Water Solutions, Inc., January 11, 2013)
- *Feed Makeup Area Soil Flushing and Downgradient Buffer Barrier (*2013 Operations Plan; Groundwater Solutions, Inc., February 27, 2013)
- *Extraction Area Groundwater Year 2012 and 2013 Remedial Action Progress Summary* (2012 and 2013 annual report; GSI Water Solutions, Inc., June 15, 2015)
- *Extraction Area Groundwater Year 2014 Remedial Action Progress Summary* (2014 annual report; GSI Water Solutions, Inc., September 15, 2015)

Table 1. Feed Makeup Area pH and Radium Data - 2013 to 2017

ATI Millersburg Operations, Oregon

Hot Spot (HS) Non Hot Spot (NHS) Perimeter (P), or Recovery	Station	Parameter	Units	ROD Standard	Spring 2013	Fall 2013	Spring 2014	Fall 2014[1]	Spring 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017
P	PW-22A	pH	--	6.5-8.5[2]	6.69	6.73	6.86	6.76	6.9	6.92	6.55	6.84	6.82
P	PW-23A	pH	--	6.5-8.5[2]	6.51	6.55	6.75	6.76	7.14	7.84	6.96	6.93	7.08
P	PW-24A	pH	--	6.5-8.5[2]	6.09	6.15	5.96	6.05	6.38	6.81	6.4	6.12	6.5
NHS	PW-27A	pH	--	6.5-8.5[2]	6.14	6.04	5.65	6	6.05	5.95	5.96	5.89	5.84
HS	PW-28A	pH	--	6.5-8.5[2]	4.12	3.8	4.16	3.19	3.24	3.87	3.87	4.25	4.19
HS	PW-50A	pH	--	6.5-8.5[2]	3.98	4.01	3.89	3.64	3.69	3.45	3.74	3.73	3.71
HS	PW-51A	pH	--	6.5-8.5[2]	6.85	7.16	6.9	6.45	6.51	6.61	6.42	6.38	6.26
HS	PW-52A	pH	--	6.5-8.5[2]	3.84	3.98	3.8	3.49	3.61	3.49	3.57	3.59	3.6
Recovery	EW-1	pH	--	6.5-8.5[2]	5.76	6.02	5.99	6.01	5.98	3.88	3.83	4.08	4.73
Recovery	EW-2	pH	--	6.5-8.5[2]	4.25	--	4.26	4.11	4.45	2.72	2.54	2.87	3.09
Recovery	EW-3	pH	--	6.5-8.5[2]	5.22	5.88	5.86	5.93	5.99	5.00	3.86	5.19	4.97
P	PW-22A	RADIUM 226	pCi/L	5[2]	0.2	-0.06	0.18	0.39	0.3	0.19	0.41	0.12	0.13
P	PW-23A	RADIUM 226	pCi/L	5[3]	0.04 U	0.1	-0.001	0.31	0.5	0.02	-0.02	0.06	0.04
P	PW-24A	RADIUM 226	pCi/L	5[3]	0.06 U	0.04	0.11	0.04	0.2	0.06	0.07	0.05	0.13
NHS	PW-27A	RADIUM 226	pCi/L	5[3]	0.2	0.09	0.03	0.62	0.3	0.08	0.1	0.2	0.03
HS	PW-28A	RADIUM 226	pCi/L	5[3]	47.5	17	21	25	35.3	8.4	11	8.3	17
HS	PW-50A	RADIUM 226	pCi/L	5[3]	1.8	1.2	1.7	0.67	2.1	1.3	0.74	0.44	0.5
HS	PW-51A	RADIUM 226	pCi/L	5[3]	0.1	0	0.06	0.34	0.4	0.22	0.12	0.2	0.62
HS	PW-52A	RADIUM 226	pCi/L	5[3]	1.6	0.42	1.8	1.7	3.3	0.32	0.25	0.29	0.25
Recovery	EW-1	RADIUM 226	pCi/L	5[3]	1.1	0.72	0.9	1.1	1.8	0.58	0.52	1.1	0.71
Recovery	EW-2	RADIUM 226	pCi/L	5[3]	8.2	--	--	14	10.6	6.3	7.7	7.6	10
Recovery	EW-3	RADIUM 226	pCi/L	5[3]	0.2	0.14	0.16	0.48	2.2	0.18	0.09	0.18	0.43
P	PW-22A	RADIUM 228	pCi/L	5[3]	0.4 U	1.9	-0.2	0.45	0.7 U	0.39	0.22	0.11	-0.09
P	PW-23A	RADIUM 228	pCi/L	5[3]	0.2 U	1.4	-1	-0.3	1.4	0.45	0.34	0.08	0.23
P	PW-24A	RADIUM 228	pCi/L	5[3]	0.2 U	1.1	-0.07	1.4	0.7 U	-0.94	0.24	-0.2	-0.3
NHS	PW-27A	RADIUM 228	pCi/L	5[3]	0.6 U	3.3	-0.1	1.4	1.5	1.4	0.45	0.05	-0.21
HS	PW-28A	RADIUM 228	pCi/L	5[3]	56.5	32	34	54	42.6	13	23	15	19
HS	PW-50A	RADIUM 228	pCi/L	5[3]	4.4	5.3	6.8	4.7	6	3.3	4.2	2.4	2.5
HS	PW-51A	RADIUM 228	pCi/L	5[3]	0.3 U	0.05	0.55	0.77	1.5	0.42	-0.3	0.49	0.7
HS	PW-52A	RADIUM 228	pCi/L	5[3]	2.6	3	2.3	0.71	4.2	3.1	3.2	1.9	1.6
Recovery	EW-1	RADIUM 228	pCi/L	5[3]	1.8	2.2	3.5	4.5	4	1.8	2.9	2.7	1.3
Recovery	EW-2	RADIUM 228	pCi/L	5[3]	24.4	--	--	31	17	16	23	18	14
Recovery	EW-3	RADIUM 228	pCi/L	5[3]	0	0.4 J	1.5	1.6	3.2	1	0.5	0.55	0.63

NOTES

[1] Fall sampling event was completed in January 2015.

[2] The ROD standard listed in the table is for a secondary maximum contaminant level (SMCL).

[3] Radium exceeds cleanup standard if total of R-226+R-228 exceeds 5 pCi/L.

Orange highlighting indicates a detected concentration that exceeds the ROD standard.

ROD standards are from Table 10-1 of the ROD (EPA. 1994).

U = Constituent not detected above method detection limit.

J = Estimated concentration below analysis reporting limit.

pCi/L = picocuries per liter.

Table 2. Feed Makeup Area Extraction Pump Details
ATI Millersburg Operations, Oregon

Station	Well Construction Data				Screen Depth		Pump Details					Pump Placement		
Extraction Well	Stick Up (feet ags)	Well Diameter (inches)	Sump Length (feet)	Screen Type	Top (feet bgs)	Bottom (feet bgs)	Pump Type	Pump Model	Pump Diameter (inches)	Pump Length (feet)	Pump Output (gpm)	Bottom of Pump (BTOC)	Actuation Point (BTOC)	Previous Actuation Point (BTOC)
EW-1	-2.0	4	3.0	0.050-inch slot V-wire wrap PVC	21	31	air	AP4+B Short Ultra	3.6	3.275	13	30.07	27.89	21.44
EW-2	-2.0	4	3.0		19	29	air		3.6	3.275	13	29.27	27.05	20.86
EW-3	-2.0	4	3.0		20	30	air		3.6	3.275	13	29.77	27.55	22.96

Notes:

ags = above ground surface

bgs = below ground surface

gpm = gallons per minute

BTOC = below top of casing

PVC = polyvinyl chloride

Actuation Point = minimum height of liquid needed to acuate the pump (controlled water level)

AP4+B Ultra, Short = a short corrosion resistant (pH 2-12) bottom filling pneumatic pump for 4-inch diameter wells

Table 3. Schedule of Feed Makeup Area Extraction Project Activities

ATI Millersburg Operations, Oregon

Date	Activity	Comment
4-6-17	Spring 2017 groundwater sampling	Project baseline analytical sampling.
6-12-17	Submit revised final Work Plan	Incorporate EPA comments from June 5, 2017 conference call.
6-28-17	Extraction well videos	Remove pumps and examine wells; Jones Drilling, Oregon.
6-29-17	Extraction well development	Re-develop EW-1, EW-2, and EW-3; Cascade Drilling, Oregon.
8-11-17	Deploy transducers into project wells	Cabled, non-vented pressure transducers; LevelScouts.
8-18-17	Complete installation of new pumps	Extraction system cleaning and flush, flow meter maintenance, replace pumps (AP4+ Ultra) and service lines.
8-19-17 to 9-5-17	Test 1: EW-1, EW-2, EW-3 pumping	Dye placed into PW-50A/28A/52A. Pumping stopped after achieving stable drawdown water levels. Extended recharge.
9-5-17 to 9-26-17	Test 2: Pump EW-2 alone	Recorded 8 days of continuous pumping data and 13 days of recharge data. Dye placed into EW-1 and EW-3.
9-26-17	Fall 2017 groundwater sampling	Analytical testing and water level collection following a 13-day recharge period with no extraction well pumping.
9-29-2017 to 10-17-17	Test 3: EW-1 and EW-3 pumping	Pumping test with no recharge cycle.
10-17-17 to 2-15-18	Restart EW-2	Standard operations: EW-1, EW-2, EW-3 pumping
4-2-18	Collect baseline analytical samples	Baseline analytical samples for pH and combined radium at EW-1, EW-2, EW-3, PW-50A, and PW-28A (project wells).
4-2-18	Shut-off EW-1 and EW-3	Begin **Phase 1** of operational modifications; extract from EW-2 alone.
May-18	2018 Spring biannual groundwater monitoring	Collect combined radium and pH from all FMA wells. 2nd quarter monitoring for extraction project wells.
Aug-18	3rd quarter groundwater monitoring at project wells	Collect combined radium and pH from project extraction wells. 3rd quarter groundwater monitoring.
Oct-18	Fall 2018 groundwater sampling	Collect combined radium and pH from all FMA wells. Performance monitoring for **Phase 1** and baseline for **Phase 2**
Oct-18	Begin pulse pumping of EW-2	**Phase 2** modification; Cycle EW-2 to pump for 16 hours and shutoff for 8 hours. Begin **Phase 2** after completion of baseline monitoring.
Dec-18	4th quarter groundwater monitoring at project wells	Collect combined radium and pH from project extraction wells. 4th quarter groundwater monitoring.
Feb-19	1st quarter groundwater sampling	EW-1, EW-2, EW-3, PW-50A, and PW-28A. Combined radium/pH.
April-19	Performance monitoring for Phase 2	EW-1, EW-2, EW-3, PW-50A, and PW-28A. Combined radium/pH.
April-19	Complete Phase 2 modifications	Resume **Phase 1** pumping after completion of **Phase 2** performance monitoring.
July-19	Submit technical memorandum to EPA	Provide Work Plan quarterly monitoring results to EPA to assist in evaluating effectiveness of extraction system modifications.

= groundwater sampling events

Table 4. Manual Water Level Measurements - 2017

ATI Miilersburg Operations, Oregon

Date	PW-50A				EW-3				PW-28A				EW-2			
	TOC (AMSL)	DTW (feet)	Offset[3] Well Cap (feet)	DTW (AMSL)	TOC (AMSL)	DTW (feet)	Offset Well Cap (feet)	DTW (AMSL)	TOC (AMSL)	DTW (feet)	Offset Well Cap (feet)	DTW (AMSL)	TOC (AMSL)	DTW (feet)	Offset Well Cap (feet)	DTW (AMSL)
4-6-17	209.08	15.70		193.38	210.18	23.54		186.64	209.13	13.16		195.97	209.66	22.04		187.62
4-11-17	209.08				210.18				209.13				209.66			
5-4-17	209.08				210.18				209.13				209.66			
6-14-17	209.08				210.18				209.13				209.66			
6-28-17[1]	209.08	15.98		193.10	210.18	21.12		189.06	209.13	14.38		194.75	209.66	20.90		188.76
6-29-17[2]	209.08				210.18	15.70		194.48	209.13				209.66	13.90		195.76
8-11-17	209.08				210.18				209.13	12.51	0.25	196.87	209.66			
8-18-17	209.08	9.78	0.13	--	210.18	12.49	1.20	198.89	209.13	12.57	0.25	196.81	209.66	12.50	1.28	198.44
9-5-17	209.08	16.10	0.13	193.11	210.18	15.39	1.20	195.99	209.13	13.35	0.25	196.03	209.66	13.24	1.28	197.70
9-26-17[4]	209.08	16.21	0.13	193.00	210.18	15.54	1.20	195.84	209.13	13.93	0.25	195.45	209.66	13.79	1.28	197.15

Date	PW-51A				PW-52A				EW-1				PW-102A[5]			Comment
	TOC (AMSL)	DTW (feet)	Offset Well Cap (feet)	DTW (AMSL)	TOC (AMSL)	DTW (feet)	Offset Well Cap (feet)	DTW (AMSL)	TOC (AMSL)	DTW (feet)	Offset Well Cap (feet)	DTW (AMSL)	TOC (AMSL)	DTW (feet)	DTW (AMSL)	
4-6-17	209.27	12.96		196.31	210.36	13.48		196.88	209.77	21.89		187.88	209.07	15.13	193.94	EW-1-2-3 pumping
4-11-17	209.27				210.36				209.77				209.07	15.13	193.94	EW-1-2-3 pumping
5-4-17	209.27				210.36				209.77				209.07	15.39	193.68	EW-1-2-3 pumping
6-14-17	209.27				210.36				209.77				209.07	15.78	193.29	EW-1-2-3 pumping
6-28-17[1]	209.27	13.70			210.36	14.08		196.28	209.77	21.02		188.75	209.07	15.58	193.49	pumping stopped
6-29-17[2]	209.27				210.36				209.77	14.89		194.88	209.07			pumps off for 20 hours
8-11-17	209.27	13.60	0.15	195.82	210.36	13.86	0.43	196.93	209.77				209.07			EW-1-2-3 pumping
8-18-17	209.27	13.91	0.15	195.51	210.36	14.25	0.43	196.54	209.77	13.76	1.20	197.21	209.07	15.50	193.57	Pumps removed 8-15-17[6]
9-5-17	209.27	14.33	0.15	195.09	210.36	14.61	0.43	196.18	209.77	13.71	1.20	197.26	209.07			Pumps off for 14 days
9-26-17[4]	209.27	14.72	0.15	194.70	210.36	14.98	0.43	195.81	209.77	14.10	1.20	196.87	209.07	15.63	193.44	Pumps off for 13 days

Notes:

[1] Recorded water levels in EW-1,EW-2, EW-3 after pulling pumps for well videos with water level rising.

[2] Waterlevels recorded approximately 20 hours after pump removal from extraction wells.

[3] Transducer support caps established a new temporary M.P.. In all cases the M.P. measurement is greater than the TOC measurement.

[4] No extraction pumping since 9-13-17. All water level measurements taken between 10 AM and 11 AM on 9-26-17 before fall groundwater sampling.

[5] PW-102A is a background well believed to be outside the ROI from the closest extraction well, EW-3.

[6] Pump removal and replacement took place 8-15-17 to 8-19-17 and included irregular periods of short pump tests. Measurements are before pumping at EW-1, EW-2, and EW-3 on 8-19-17.

TOC= top of casing

amsl = above mean sea level

DTW = depth to water

M.P. = measuring point

FIGURE 1

Source Area Overview

Feed Makeup Area
ATI Millersburg Operations, Oregon

LEGEND

- Source Area Monitoring Well
- Extraction Area Monitoring Well
- Extraction Well
- Former Feed Transfer Line
- Former Feed Deck
- Former Feed Tanks

N

0 15 30 45
Feet

Date: March 26, 2018
Data Sources: City of Albany, DigiGlobe 2016

GSI Water Solutions, Inc.

Document Path: P:\Portland\168 - Wah Chang\GIS\2017_026\Project_mxds\FMA_Soil_Flushing_Report\Figure1_FMA_Site_Map.mxd

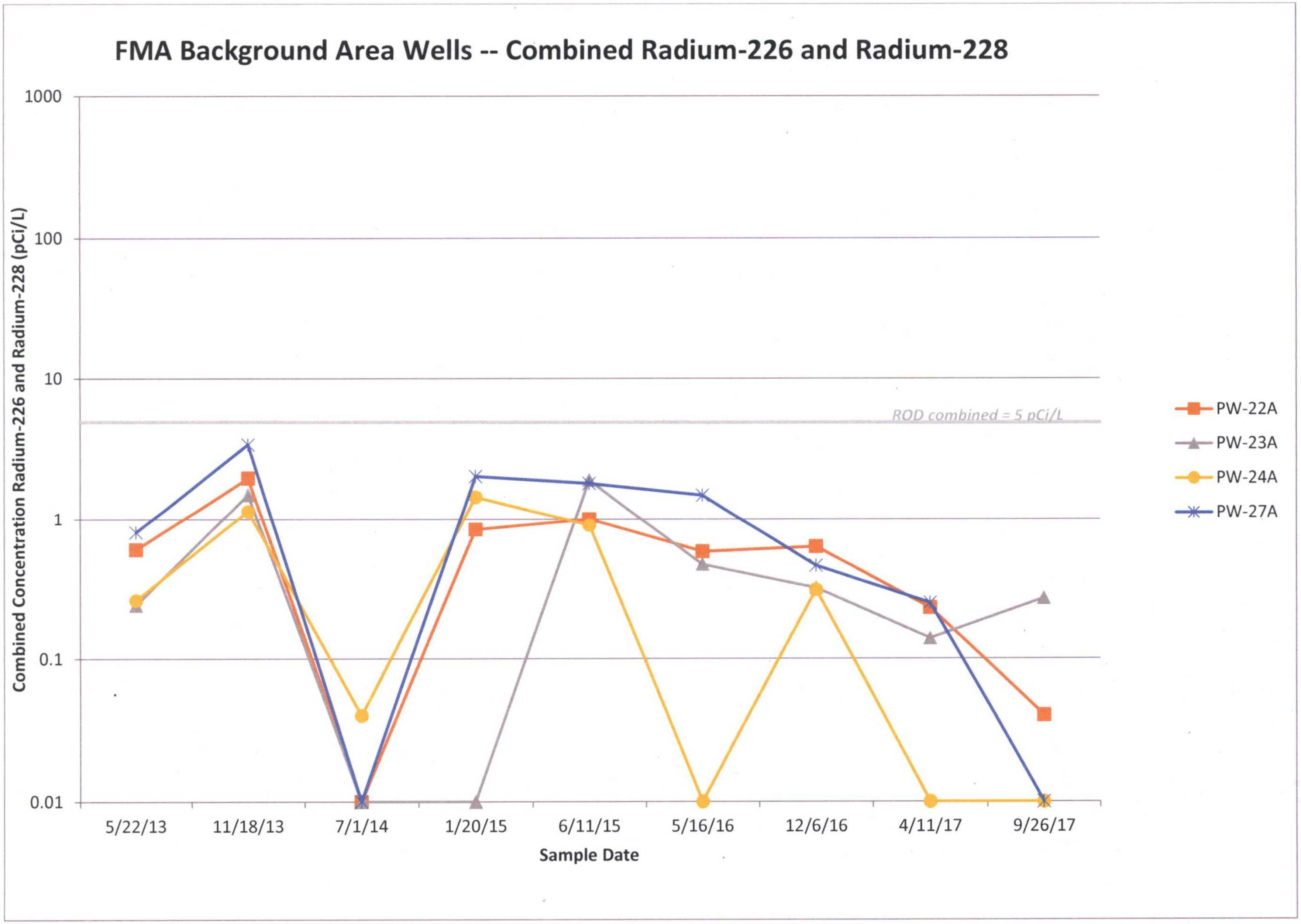

Figure 2

Combined Radium-226 / 228 Concentrations in FMA Background Wells Versus Time

ATI Millersburg Operations, Oregon

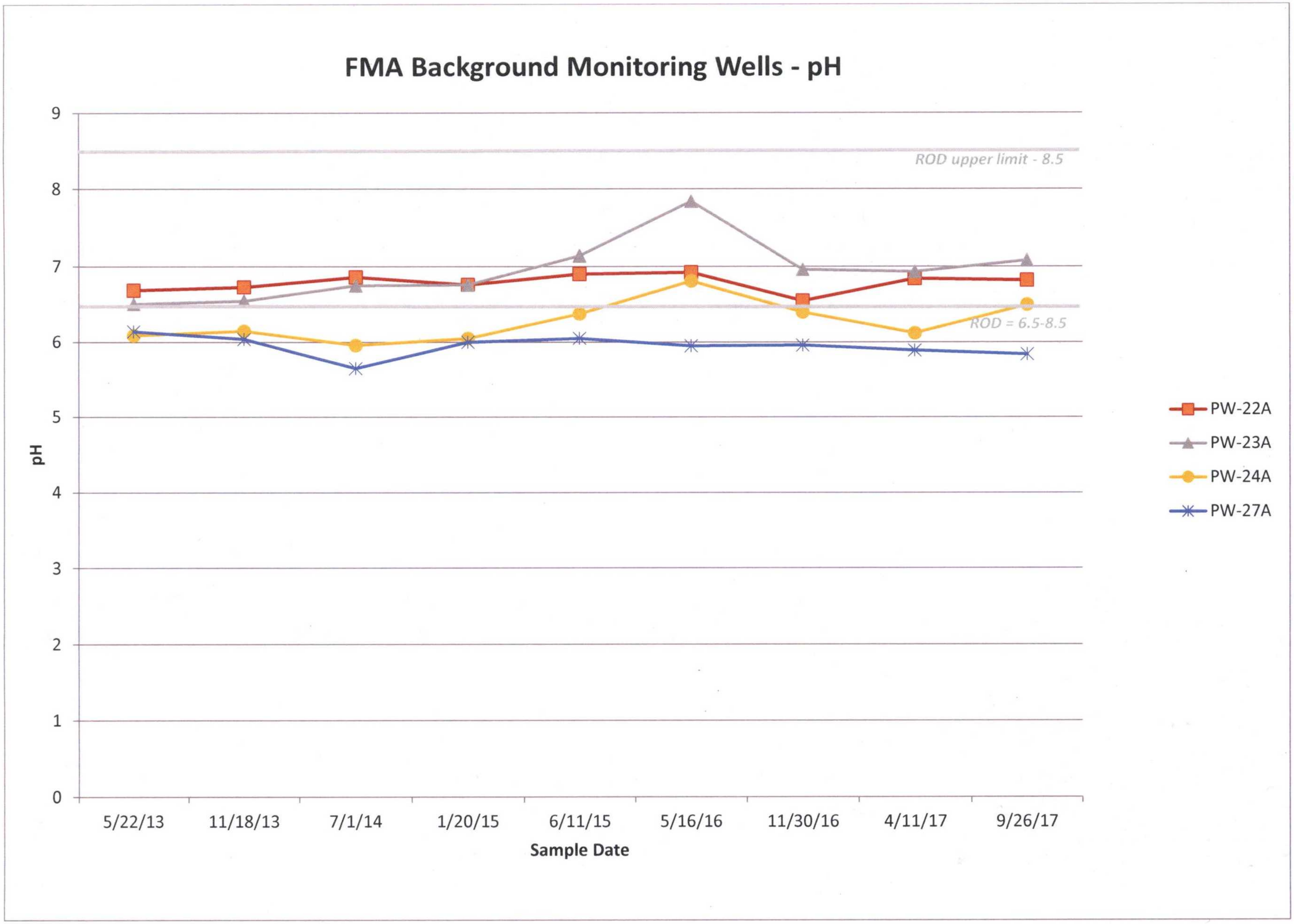

Figure 3

pH Values in FMA Background Wells Versus Time

ATI Millersburg Operations, Oregon

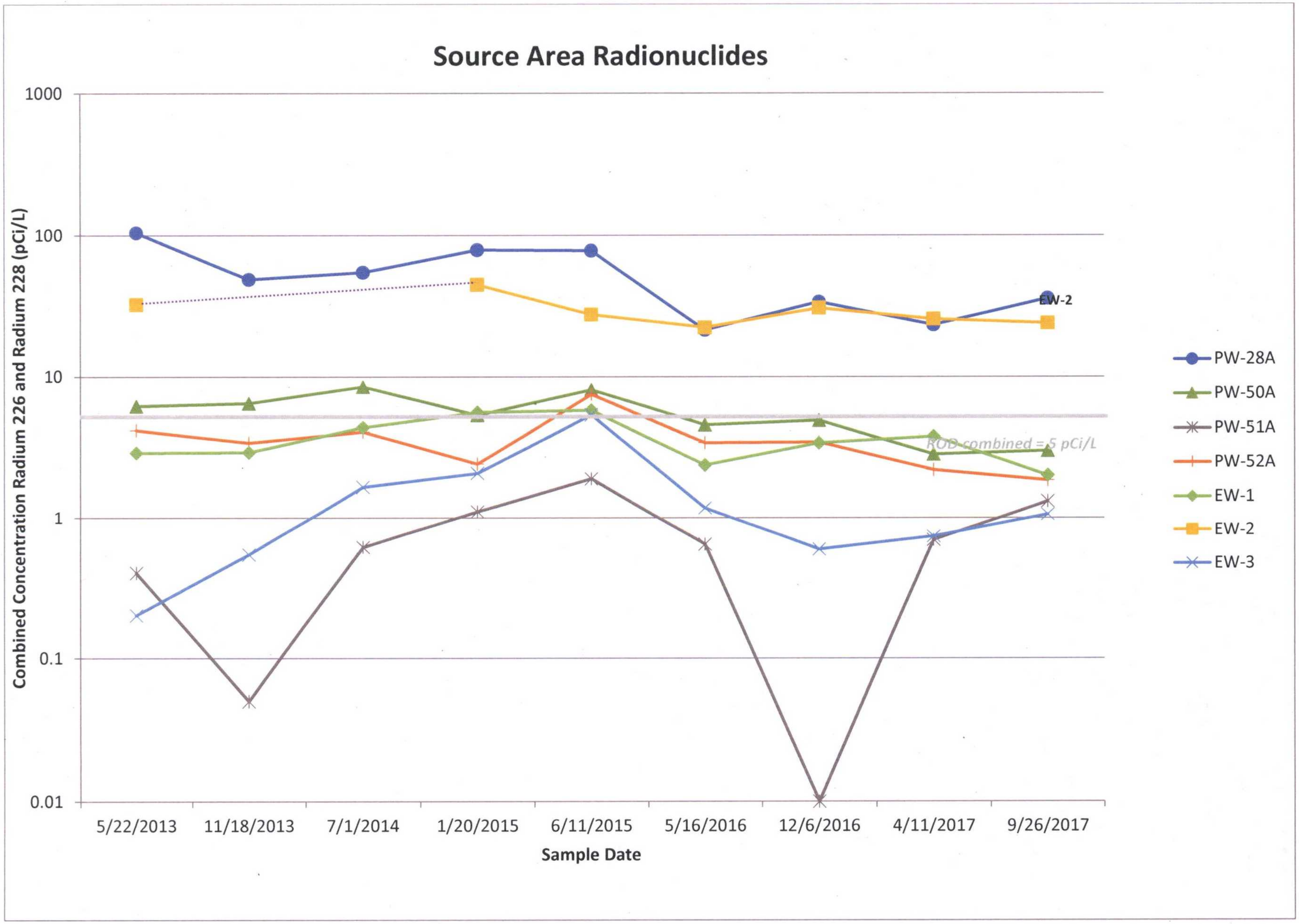

Figure 4

Combined Radium 226 / 228 Concentrations in FMA Source Wells Versus Time

ATI Millersburg Operations, Oregon

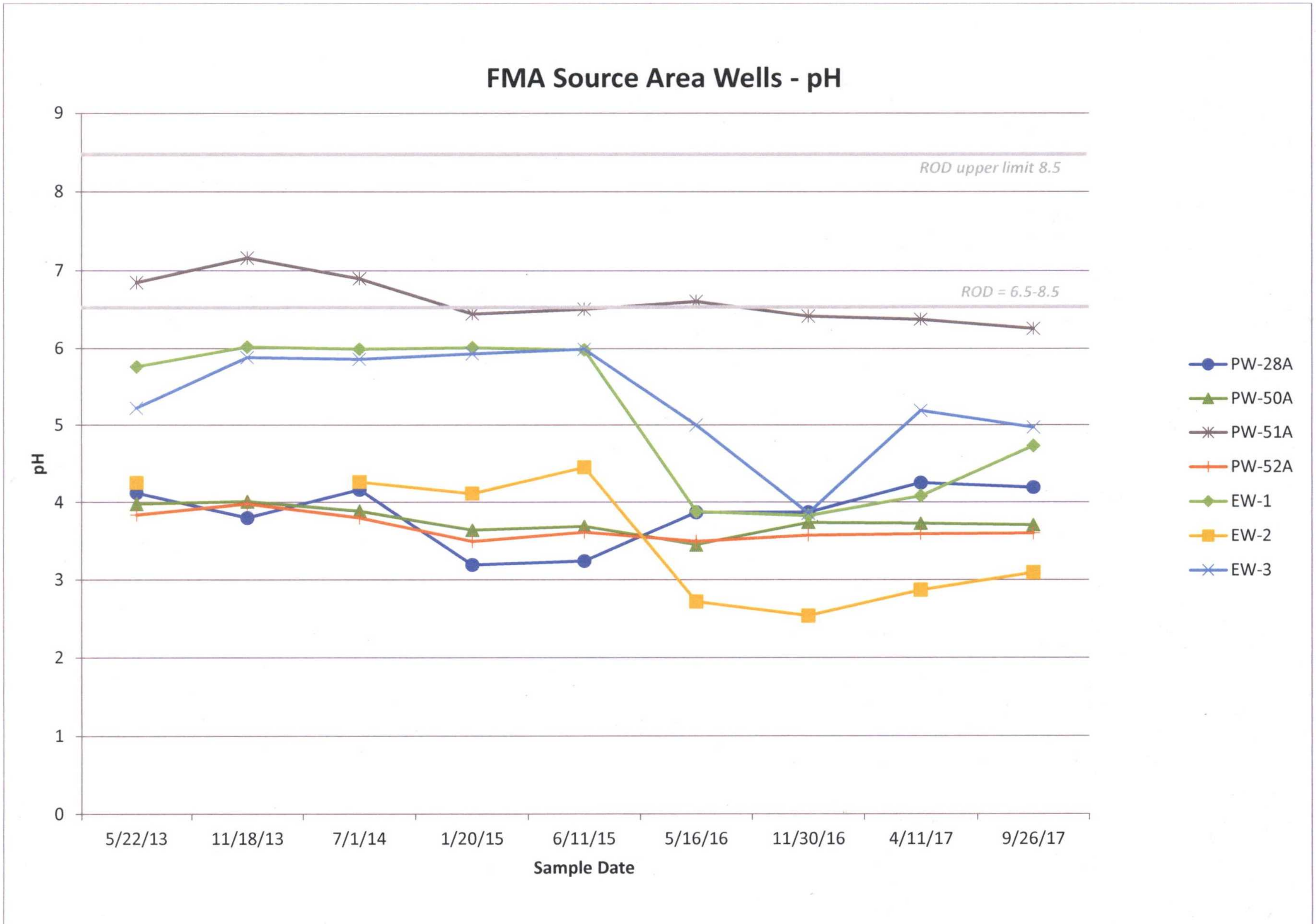

Figure 5

pH Values in FMA Source Area Wells Versus Time

ATI Millersburg Operations, Oregon

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FIGURE 6

pH and Radium Concentrations September 2017

Feed Makeup Area
ATI Millersburg Operations, Oregon

LEGEND

- Monitoring Well
- Extraction Well
- Roads
- Railroad

Well Type

- Background Well
- Source Area Well

N

0 25 50 75
Feet

Date: February 12, 2018
Data Sources: City of Albany, ATI

GSI Water Solutions, Inc.

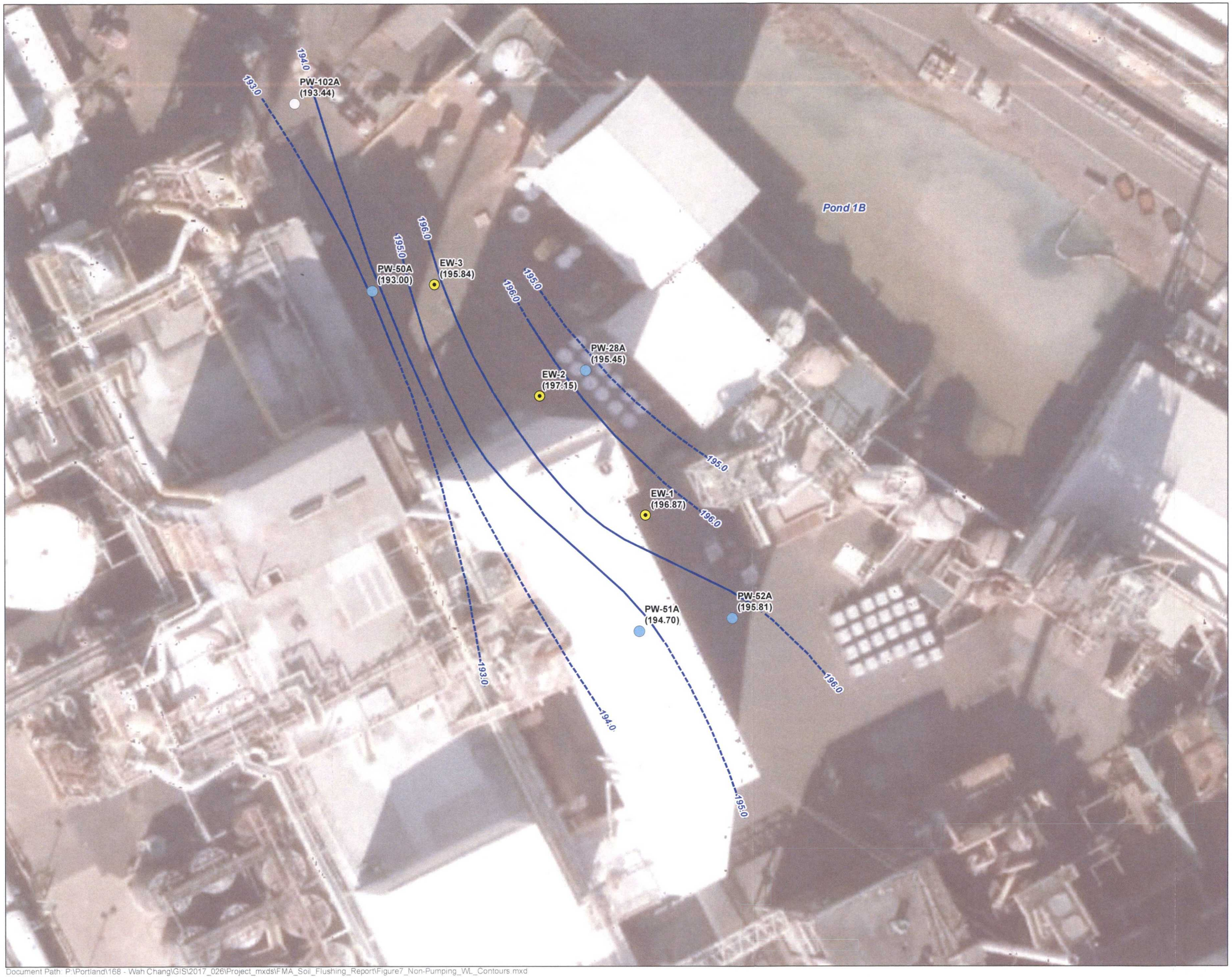

FIGURE 7

Groundwater Elevation Contours No Extraction Pumping

Feed Makeup Area
ATI Millersburg Operations, Oregon

LEGEND

- Source Area Monitoring Well and Groundwater Elevation (feet)
- Extraction Area Monitoring Well and Groundwater Elevation (feet)
- Extraction Well and Groundwater Elevation (feet)
- Groundwater Contour, September 26, 2017 (dashed where inferred)

NOTES:
NM: Not Measured
1. Extraction wells shut-off for 13 days before water level measurements.

N

0 15 30 45
Feet

GSI Water Solutions, Inc.

Date: March 28, 2018
Data Sources: City of Albany, DigiGlobe 2016

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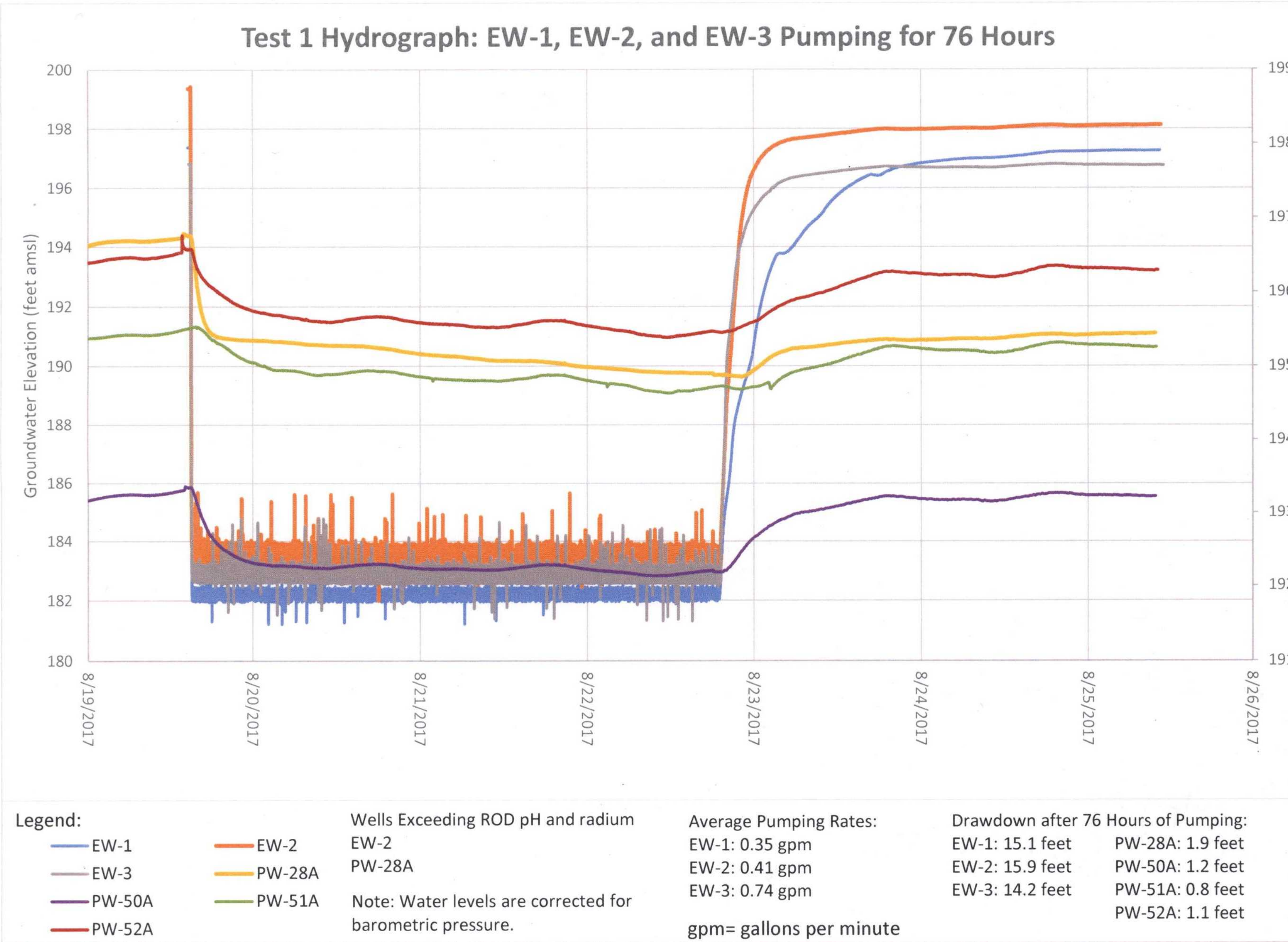

Figure 8

EW-1, EW-2, and EW-3 Pumping Hydrograph

ATI Millersburg Operations, Oregon

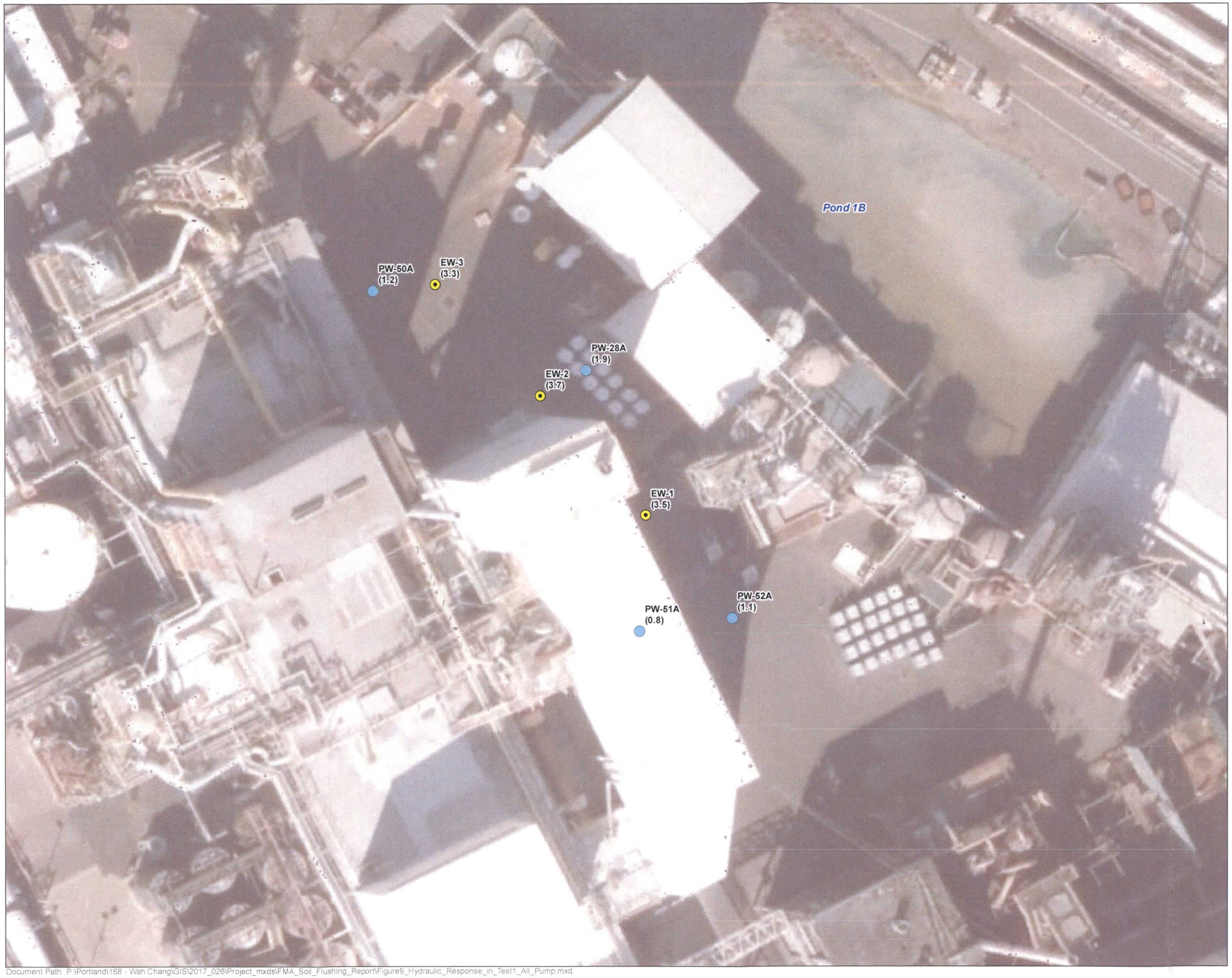

FIGURE 9

Hydraulic Response to EW-1, EW-2 and EW-3 Pumping

Feed Makeup Area
ATI Millersburg Operations, Oregon

LEGEND

- Source Area Monitoring Well and Drawdown (feet)
- Extraction Well and Drawdown (feet)

NOTES:
1. Groundwater Elevations measured 36 hours after pumping started on August 19, 2017.
2. Drawdowns at extraction wells assume a well efficiency of 23 percent.
3. PW-102A groundwater elevation collected August 18, 2017

N

0 15 30 45
Feet

Date: March 28, 2018
Data Sources: City of Albany, DigiGlobe 2016

GSI Water Solutions, Inc.

Document Path: P:\Portland\168 - Wah Chang\GIS\2017_026\Project_mxds\FMA_Soil_Flushing_Report\Figure9_Hydraulic_Response_in_Test1_All_Pump.mxd

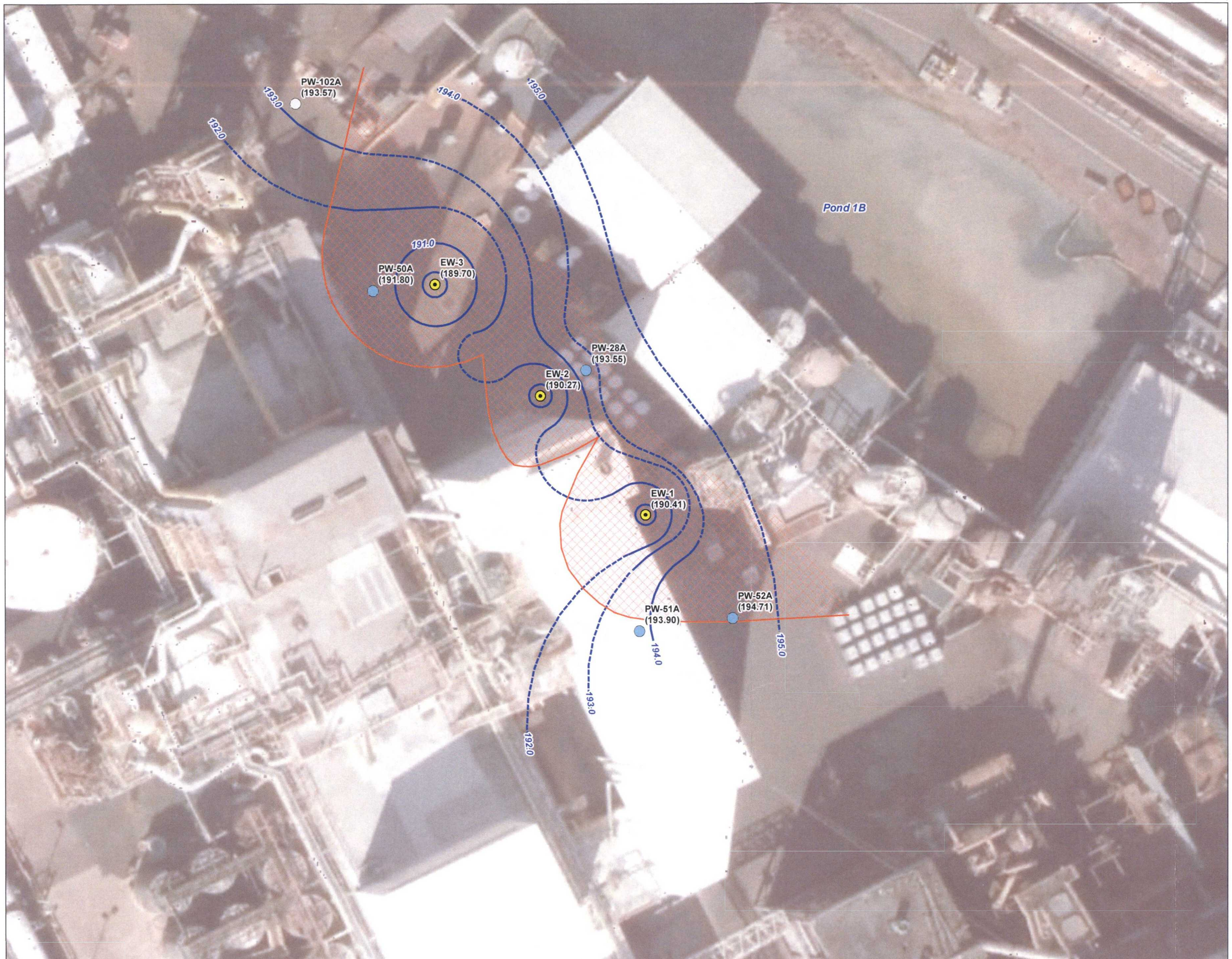

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FIGURE 10

Groundwater Elevation Contours, EW-1, EW-2 and EW-3 Pumping

Feed Makeup Area
ATI Millersburg Operations, Oregon

LEGEND

- Source Area Monitoring Well and Groundwater Elevation (feet)
- Extraction Area Monitoring Well and Groundwater Elevation (feet)
- Extraction Well and Groundwater Elevation (feet)
- Groundwater Contour, August 20, 2017 (dashed where inferred)
- Capture Zone

NOTES:

1. Groundwater Elevations measured 36 hours after pumping started on August 19, 2017.
2. Drawdowns at extraction wells assume a well efficiency of 23 percent.
3. PW-102A groundwater elevation collected August 18, 2017

N

0 15 30 45
Feet

Date: March 30, 2018
Data Sources: City of Albany, DigiGlobe 2016

GSI Water Solutions, Inc.

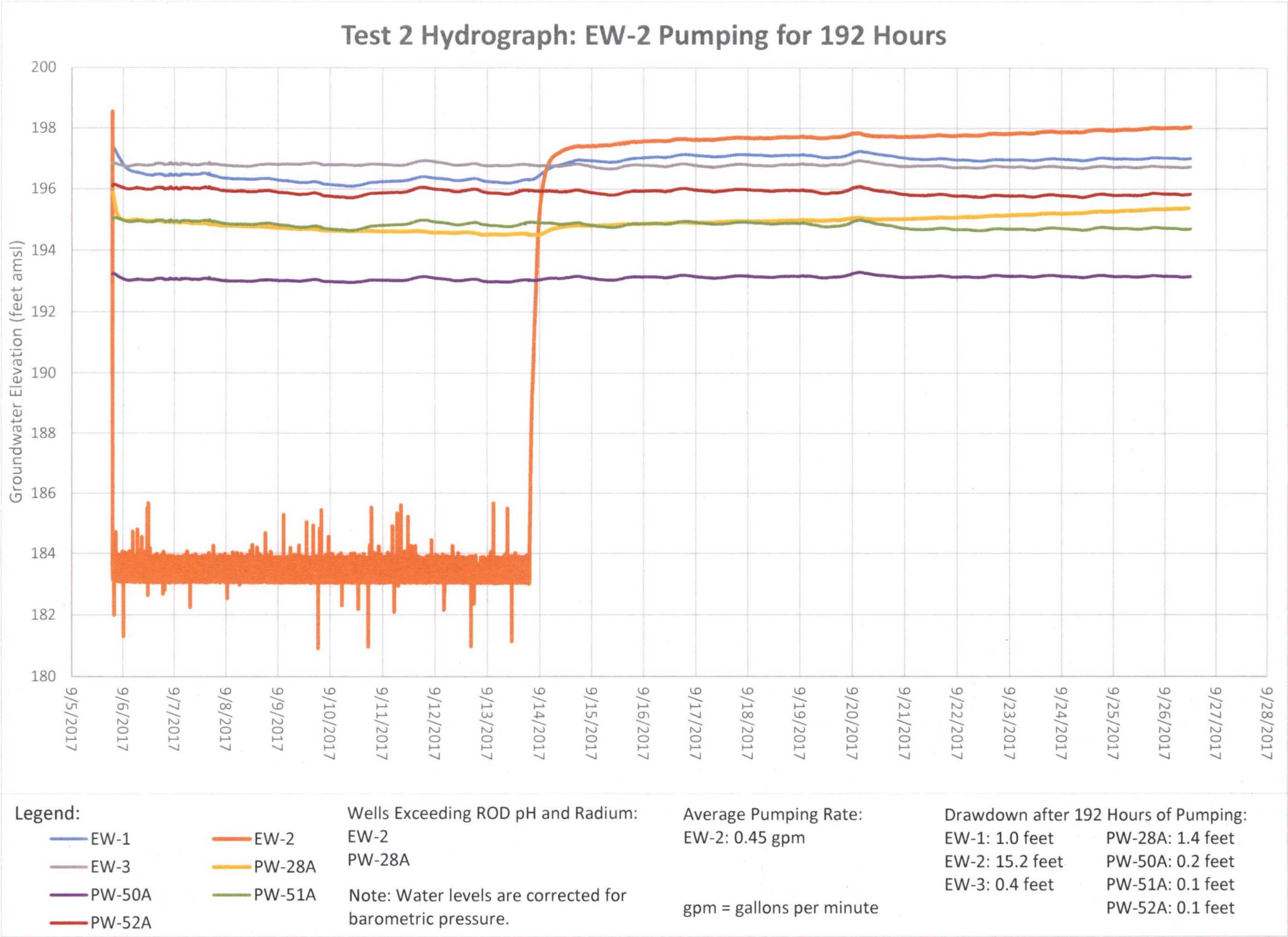

Figure 11
EW-2 Pumping Hydrograph
ATI Millersburg Operations, Oregon

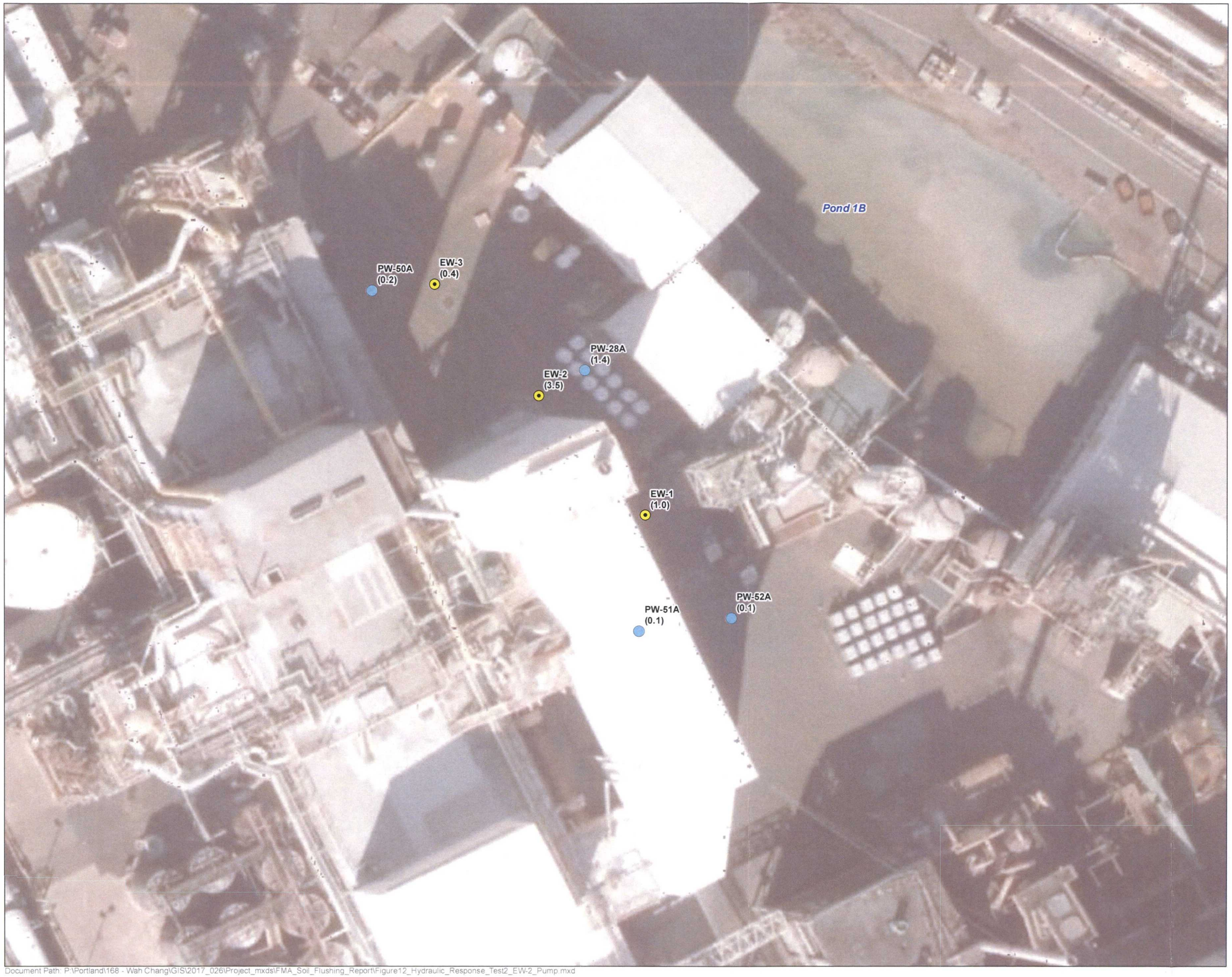

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FIGURE 12

Hydraulic Response to EW-2 Pumping

Feed Makeup Area
ATI Millersburg Operations, Oregon

LEGEND

- Source Area Monitoring Well and Drawdown (feet)
- Extraction Well and Drawdown (feet)

NOTES:

1. Groundwater Elevations measured 72 hours after pumping started on September 5, 2017.
2. Drawdowns at extraction wells assume a well efficiency of 42.8 percent.

N

0 15 30 45
Feet

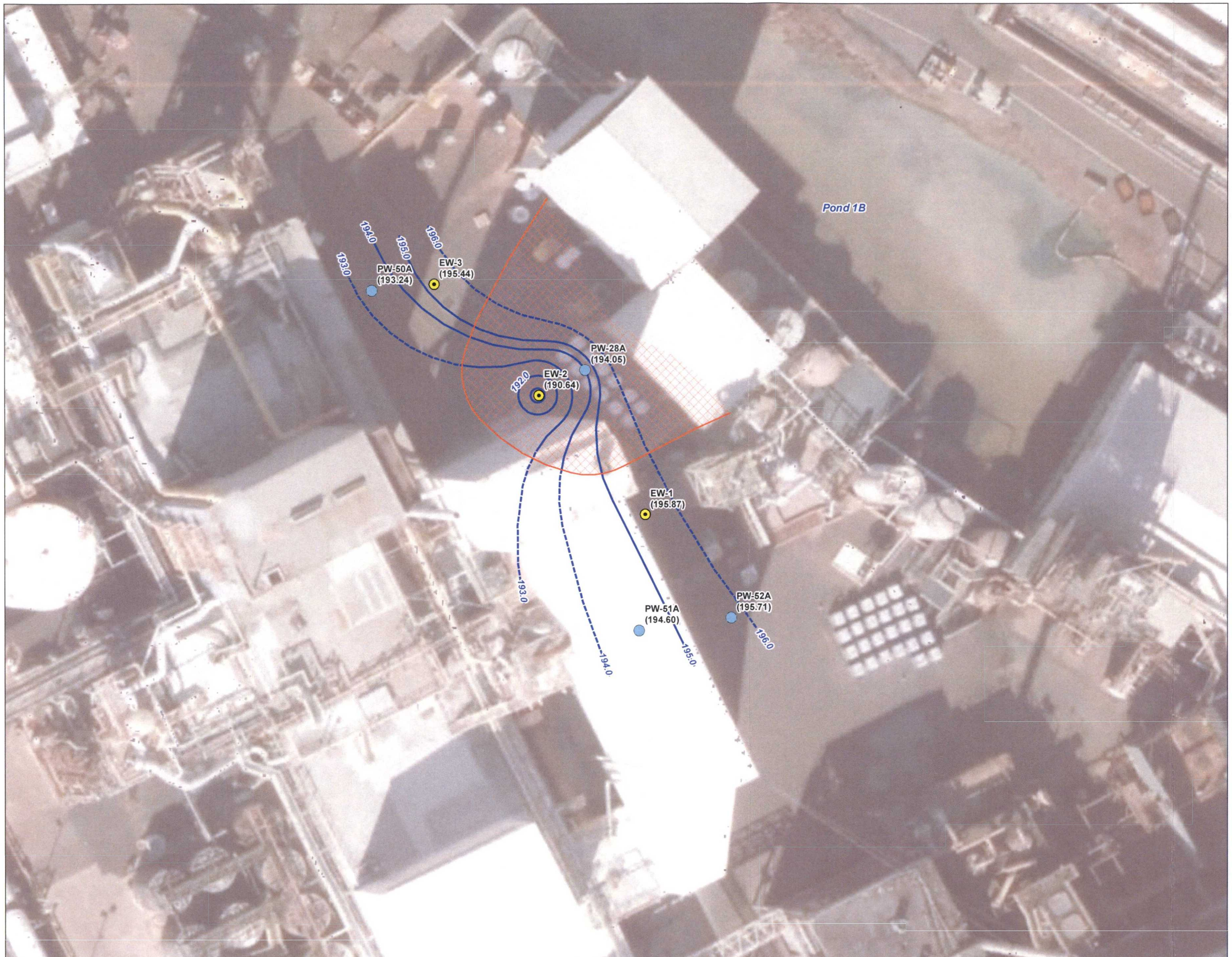
GSI Water Solutions, Inc.

Date: March 28, 2018
Data Sources: City of Albany, DigiGlobe 2016

FIGURE 13

Groundwater Elevation Contours, EW-2 Pumping

Feed Makeup Area
ATI Millersburg Operations, Oregon



LEGEND

- Source Area Monitoring Well and Drawdown (feet)
- Extraction Well and Groundwater Elevation (feet)
- Groundwater Contour, August 20, 2017 (dashed where inferred)
- Capture Zone

NOTES:

1. Groundwater Elevations measured 72 hours after pumping started on September 5, 2017.
2. Drawdowns at extraction wells assume a well efficiency of 42.8 percent.

N

0 15 30 45
Feet

GSI Water Solutions, Inc.

Date: March 30, 2018
Data Sources: City of Albany, DigiGlobe 2016

Document Path: P:\Portland\168 - Wah Chang\GIS\2017_026\Project_mxds\FMA_Soil_Flushing_Report\Figure13_GW_Elevation_Contours_Test2_EW-2_Pump.mxd

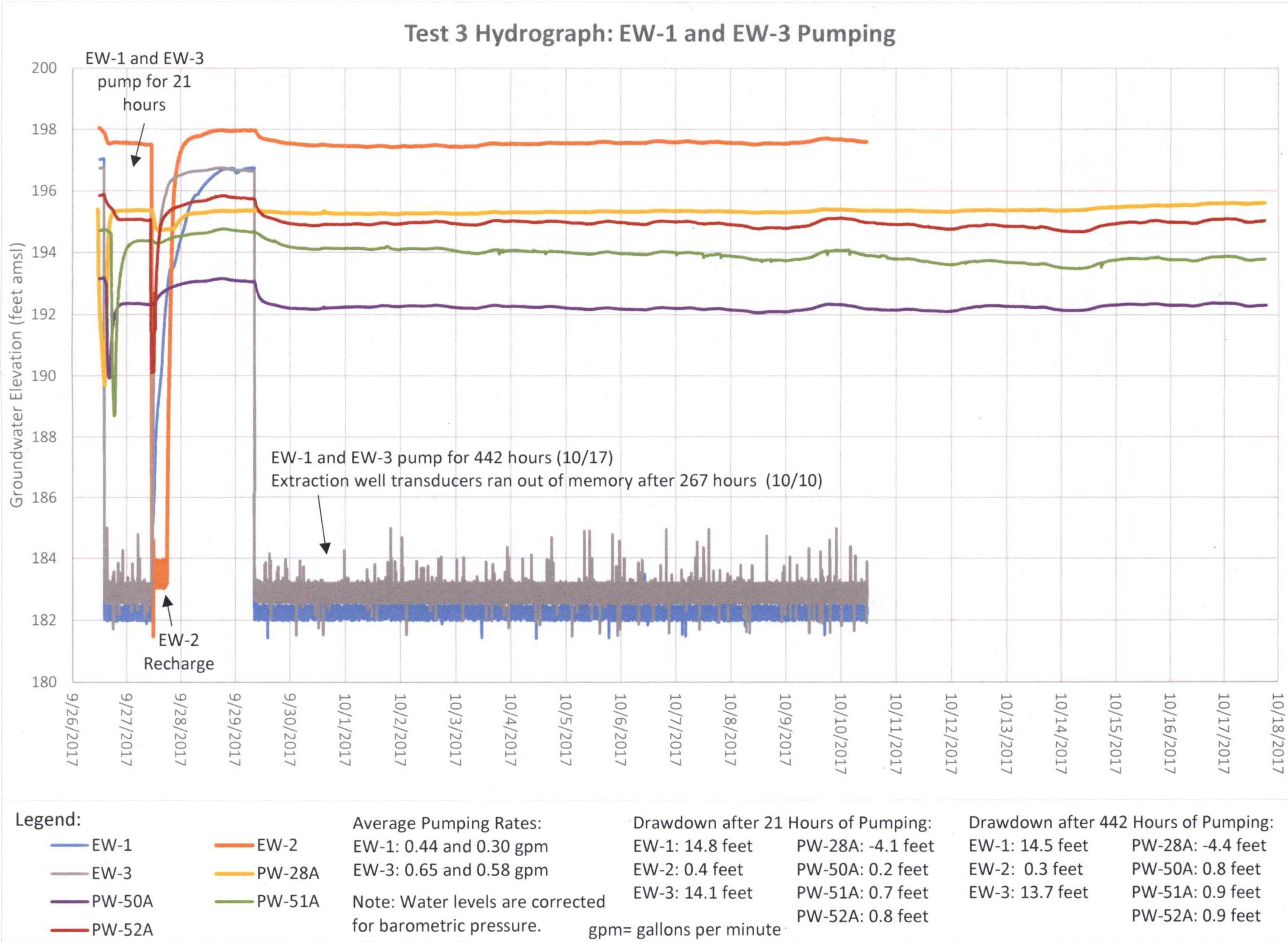


Figure 14
EW-1 and EW-3 Pumping Hydrograph
ATI Millersburg Operations, Oregon

CH2M HILL

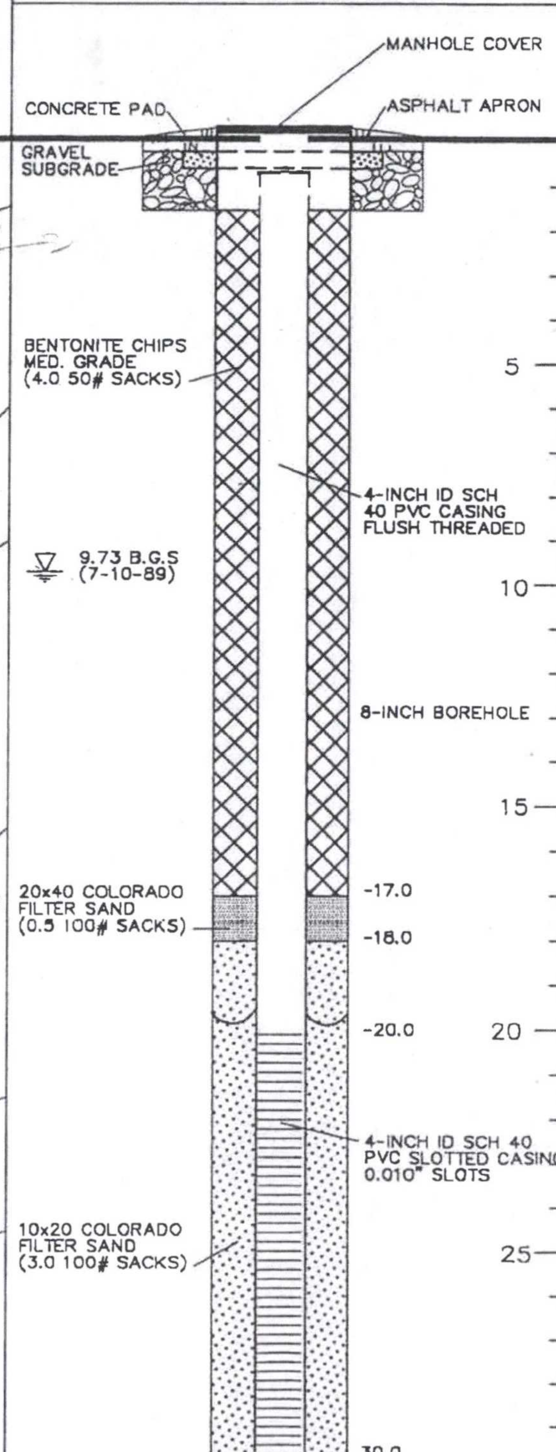
MONITORING WELL GEOLOGIC + CONSTRUCTION LOG

PROJECT NUMBER	WELL NUMBER	
CVO22806.RI	PW-28A	SHEET 1 OF 2

PROJECT TELEDYNE WAH CHANG
LOCATION ALBANY, OREGON
ELEVATION, NGVD (Top of Well Casing) 209.13
SURFACE ELEVATION, NGVD 209.3
WATER LEVEL ELEVATION, NGVD 199.57 (7/10/89)
START DATE 4/26/89
DRILLING CONTRACTOR ONWEGO DRILLING CO., KENNEWICK, WA
FINISH DATE 4/28/89
DRILLING METHOD BUCYRUS ERIE CABLE TOOL
HYDROGEOLOGIST SCOTT WILBUR

DEPTH (Ft)	SAMPLE: Recovery (%)	SAMPLE: Blows	GEOLOGIC LOG & FIELD OBSERVATIONS / OVA READING ( )	USCS DESIGNATION
	93	9-8-3	GRAVEL WITH SILT, moist, medium, silt material at the end of the split spoon, gravel appears to be fill material, wood in sample, (0)	GM
	100	1-1-4	WOOD MATERIAL WITH SOME FINES, moist, soft, fines are plastic, water is entering borehole, at 3.5 feet, (0)	OL
5	NR	NR	WOOD WITH SILT, volatile sample collected from silt portion of sample, because of the large amounts of wood no rad, total metals, or base metals were collected, (60 ppm)	
	NR	NR	POORLY GRADED SAND WITH SILT, fine, 10YR-6/1 gray with brownish yellow mottling, 20 percent moisture content, stiff, organics, wood chips, (0)	SP
10	NR	10-12-20	WELL GRADED GRAVEL WITH SAND AND SILT, 10YR-3/3 gray, moist, dense, 5 percent silt, 40 percent sand, 55 percent gravel, (0)	GW
	NR	16-13-28	AS ABOVE	
15	NR	12-14-30	WELL GRADED GRAVEL WITH SAND AND SILT, 10YR-3/3 gray, moist, dense, driller is not adding as much water, (0)	
	NR	NR	SAND WITH GRAVEL, 7.5YR-4/6 strong brown, moist, split spoon shows bedding layers of sand size materials grading into gravels, several layers (#4) were present, sand fraction dominates sampler, (0)	SP-SW
20	NR	NR	SAND WITH GRAVEL, 7.5YR-4/6 strong brown, moist, sample contains a large basalt section at the end of the split spoon, (0)	
	NR	38-18-18	POORLY GRADED GRAVEL WITH SAND AND SILT, 10YR-3/3 dark brown, moist, dense, (0)	GP
25	NR	38-50/5"	SILTY GRAVEL, poorly graded, 10YR-3/3 dark brown, wet, very dense, loose silty matrix, (7 ppm)	GM
	NR	40-50/6"	AS ABOVE	

WELL CONSTRUCTION



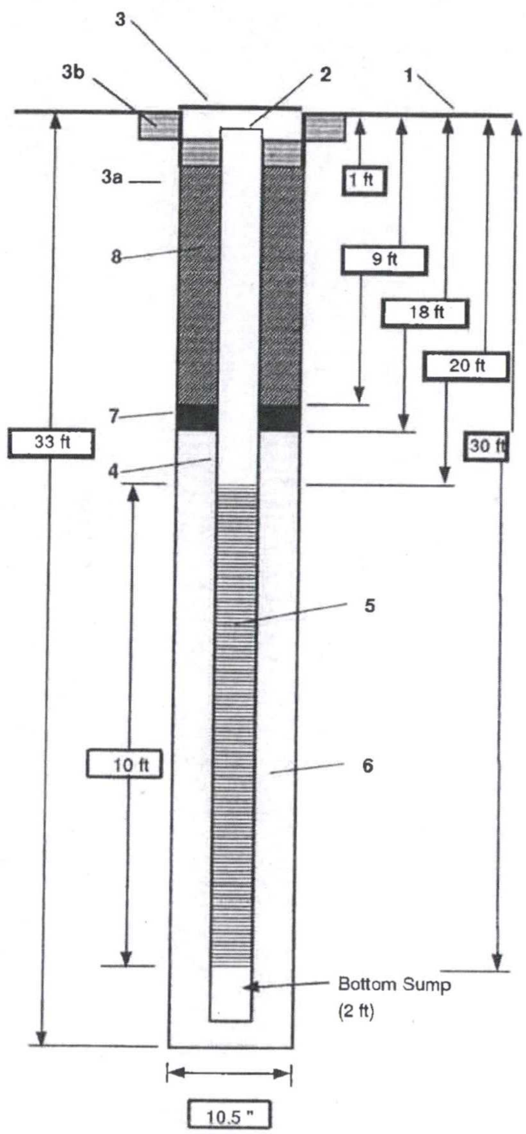
J:\CIVILPRJ\BORING

PROJECT NUMBER	WELL NUMBER	
137218.FM.ZZ	PW-50A	SHEET 1 OF 1

CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT : Feed Makeup Area Well PW-50A **LOCATION :** Wah Chang
DRILLING CONTRACTOR : Geo-Tech Explorations, Tualatin, OR Albany, OR
DRILLING METHOD AND EQUIPMENT USED : HSA; 8 1/4" augers **ELEVATION [ft NVGD]:** ~~209.08~~ 208.28
WATER LEVELS : approx. 20 ft bgs **START :** 10/18/97 **END :** 10/19/97 **LOGGER :** D. Mustonen



1- Ground elevation at well

2- Top of casing elevation 209.08 ~~210.11~~ ft NVGD

3- Wellhead protection cover type: Sherwood Flush Mount
   a) drain tube? no
   b) concrete pad dimensions: n/a; integrated in paved road

4- Dia./type of well casing: 4" PVC SCH 40

5- Type/slot size of screen: 0.020" slot; pre-packed screen

6- Type screen filter: Colorado Silica Sand 10x20
   a) Quantity used: 15x50-lb bags

7- Type of seal: Bentonite chips (3/4"): 9x50-lb bags
   a) Quantity used: Granular Bentonite: 12x50-lb bags

8- Grout: n/a
   a) Grout mix used
   b) Method of placement
   c) Vol. of well casing grout

Development method: Surge and overpump (11-13-97)

Development time: 3 hours

Estimated purge volume: 100 gallons

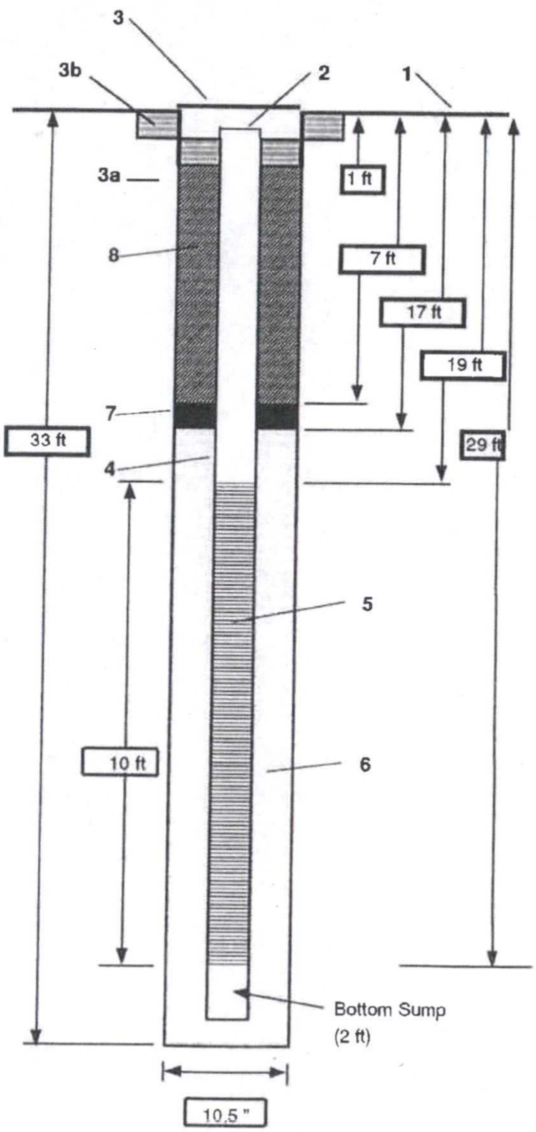
Comments

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
137218.FM.ZZ	PW-51A	SHEET 1	OF 1

WELL COMPLETION DIAGRAM

PROJECT : Feed Makeup Area Well PW-51A **LOCATION :** Wah Chang
DRILLING CONTRACTOR : Geo-Tech Explorations, Tualatin, OR Albany, OR
DRILLING METHOD AND EQUIPMENT USED : HSA; 8 1/4" augers **ELEVATION [ft NVGD]:** ~~209.27~~ 209.63
WATER LEVELS : approx. 20 ft bgs **START :** 10/18/97 **END :** 10/18/97 **LOGGER :** D. Mustonen



1- Ground elevation at well: 209.27

2- Top of casing elevation: ~~210.33~~ ft NVGD

3- Wellhead protection cover type: Sherwood Flush Mount
   a) drain tube?: no
   b) concrete pad dimensions: n/a; integrated in paved road

4- Dia./type of well casing: 4" PVC SCH 40

5- Type/slot size of screen: 0.020" slot; pre-packed screen

6- Type screen filter: Colorado Silica Sand 10x20
   a) Quantity used: 10x50-lb bags

7- Type of seal: Bentonite chips (3/4"): 12x50-lb bags
   a) Quantity used: Granular Bentonite: 8x50-lb bags

8- Grout: n/a
   a) Grout mix used
   b) Method of placement
   c) Vol. of well casing grout

Development method: Surge and overpump (11-13-97)

Development time: 3.5 hours

Estimated purge volume: 135 gallons

Comments

CH2MHILL

PROJECT NUMBER :	WELL NUMBER :
153918.CC.E6.P1	PW-52A

WELL CONSTRUCTION DIAGRAM

PROJECT : Extraction Area Phase I Remedial Action — LOCATION : **PW-52A**

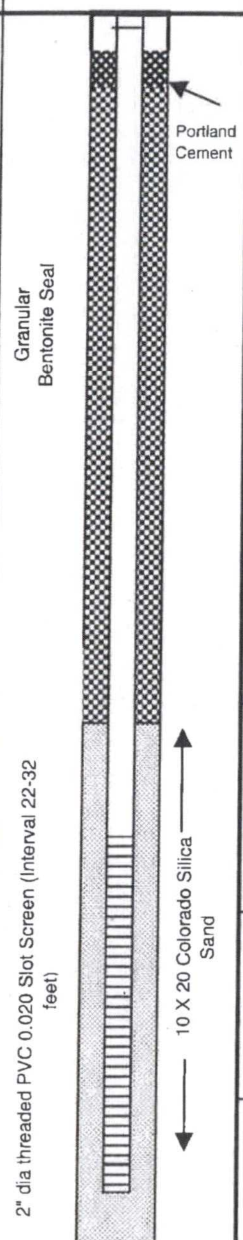
ELEVATION : Not Measured — DRILLING CONTRACTOR : Geotech Exploration Inc.

DRILLING METHOD AND EQUIPMENT USED : 6.25-inch Diameter Hollow Stem Auger/3-inch SPT, and 6-inch Continuous Core Barrel Sampler

WATER LEVELS : 26-feet — START : 11/18/1999 — END : 11/18/1999 — LOGGER: David T. Mustonen

DEPTH BELOW SURFACE (FT)

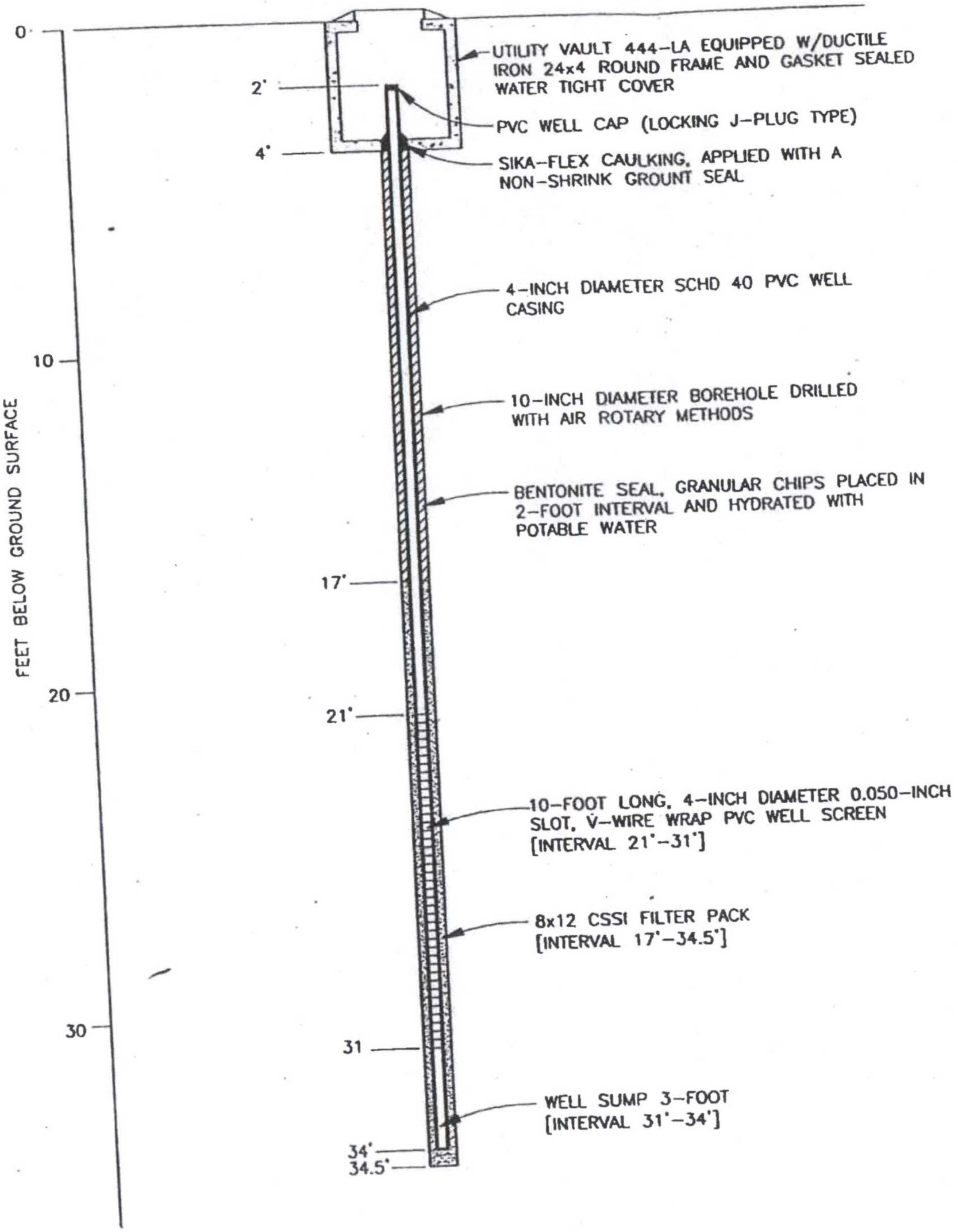
CONSTRUCTION DIAGRAM
Flush Mount



Interval	Sample Length (ft)	Recovery (ft)	Standard Penetration Test Results 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: HEAD SPACE RESULTS, SOIL SAMPLES, OTHER
5-6.5	1.5	1.5	SPT 7-9-14	Tan Stiff Silt (Dry)	PID = 0 pH = 6
				Driller notes gravels encountered at depth of 14-foot	
15-18.5	3.5	3.5	Core Barrel	15 to 16-foot interval: Silty Gravel and Medium Sand with some cobbles, perched groundwater encountered. 16 to 17-foot interval: Cemented Sandy Small Gravel (1/2-inch minus), with some Silt. (Moist) 17.5 to 18.5-foot interval: Cemented Medium Sand (Moist)	PID = 0 pH = 4
19-24	5	5	Core Barrel	19 to 24-foot interval: Cemented Well Graded Medium Size Gravel (4-inch minus). Bright Orange Staining Color, suggesting groundwater table fluctuation. Gravels bedded with Medium Sand matrix (Moist)	PID = 0 pH = 4
24-29	5	5	Core Barrel	24 to 29-foot interval: Cemented Sandy Medium Sized Gravel (4-inch minus) with Silt Binder. Fully Saturated but only minor amount of groundwater available. Higher Silt fraction at 29-foot. **GROUNDWATER ENCOUNTERED AT 26-FEET.**	Collect composite sample for sieve analysis from 25 to 29 foot interval PID = 0 pH =5
29-34	5	5	Core Barrel	29 to 32-foot interval: Partially Cemented Sandy Medium Sized Gravel (4-inch minus) minor Silt Binder. Completely Saturated although significant groundwater not produced from borehole. 32 to 34-foot interval: Tan Stiff Silty Clay, at depth of 33.5 foot encounter Stiff Black Clay. **END OF BORING-34-foot**	Collect composite sample for sieve analysis from 29 to 32 foot interval PID = 0 pH = 5

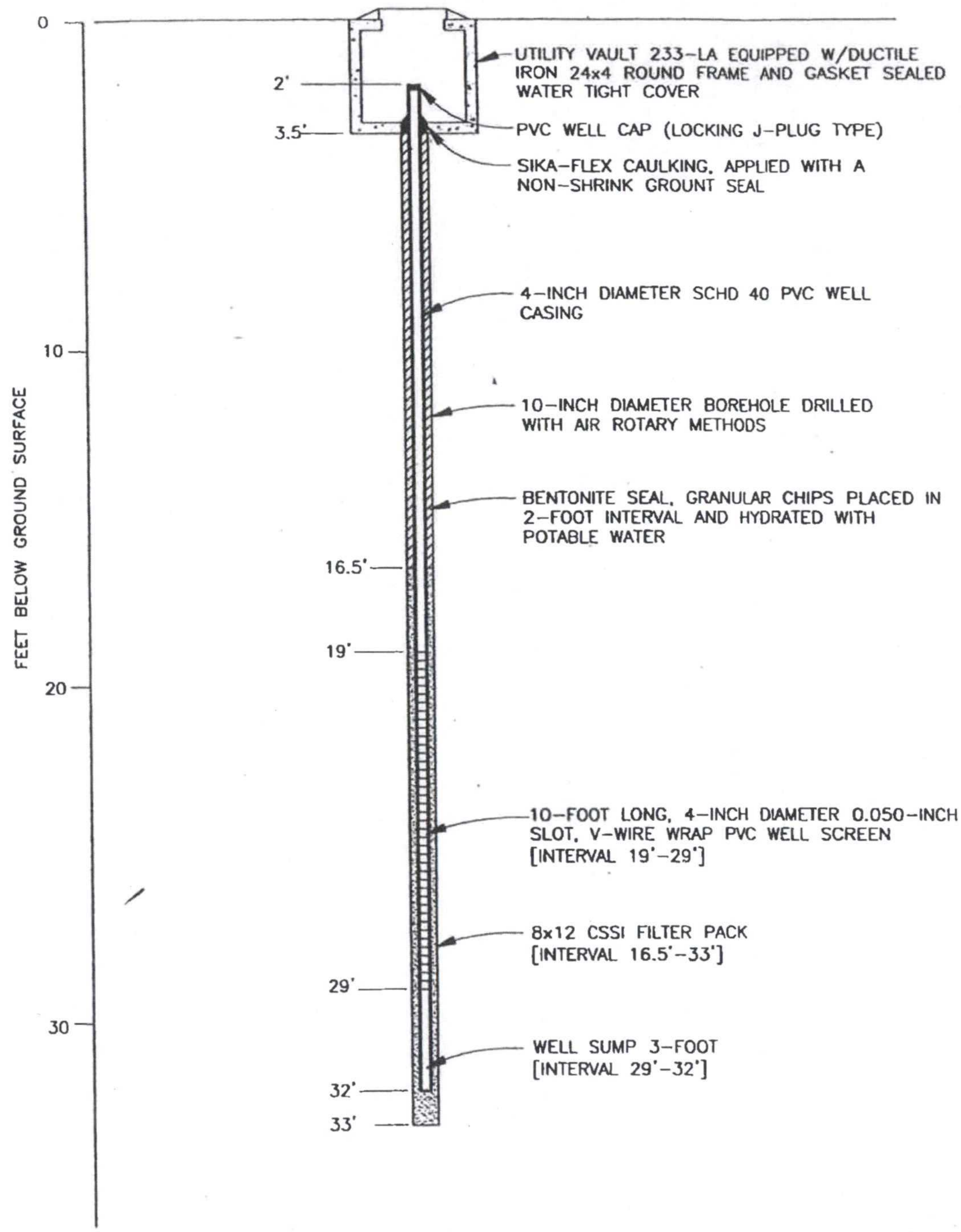
MIDWAY\PRJ\OREMET\OREMET LANDFILL\PAR\153918W1.DWG

EW-1 EXTRACTION WELL DETAIL



NO.	REVISIONS	DATE	BY	APPD.	NO.	REFERE
6						
5						
4						
3						
2						
1						

EW-2 EXTRACTION WELL DETAIL



6						
5						
4						
3						
2						
1						
NO.	REVISIONS	DATE	BY	APPD.	NO.	REFERENCE DRAWIN

EW-3 EXTRACTION WELL DETAIL

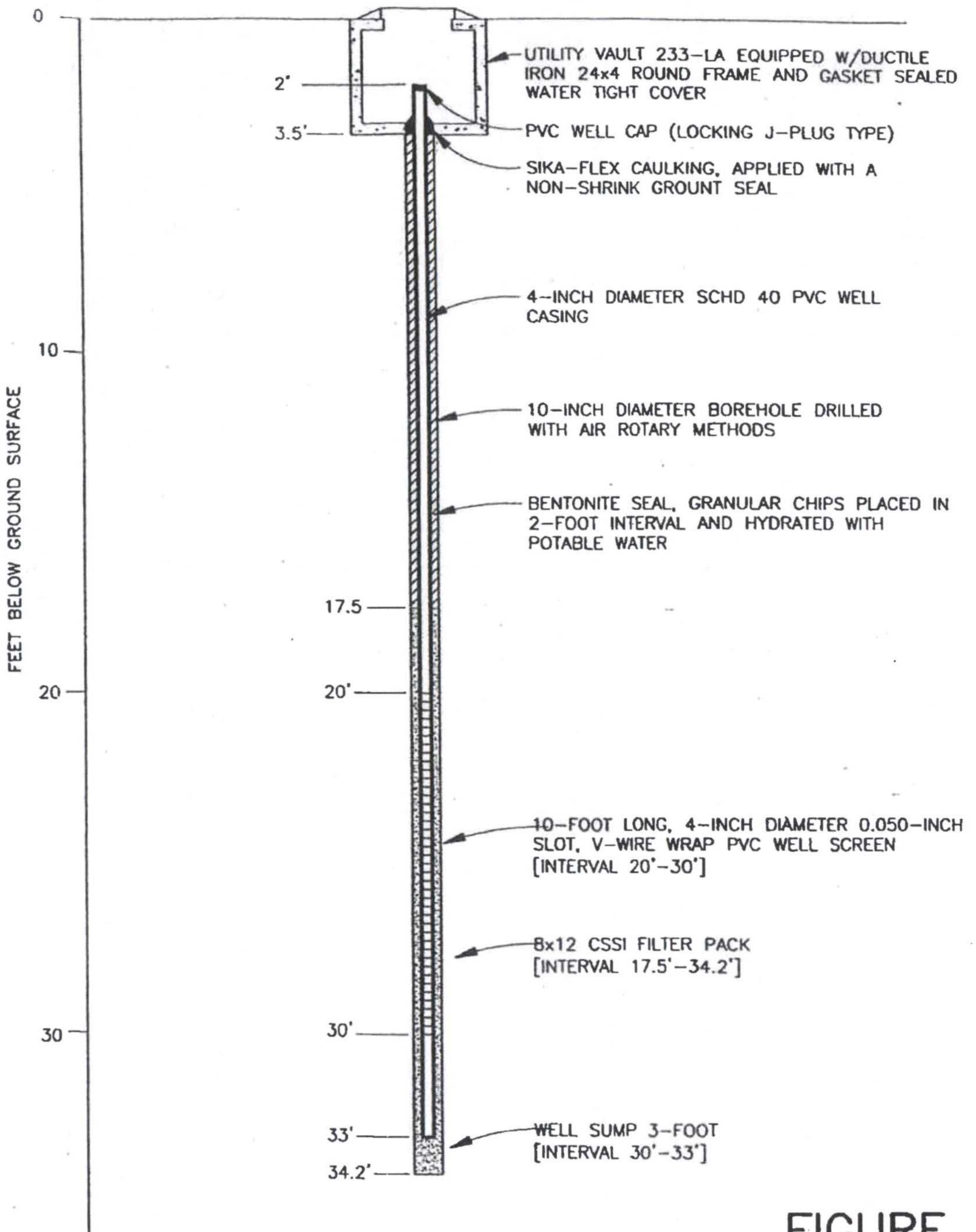


FIGURE 10

EQUIPMENT NO.

TOLERANCE ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
1PL ±0.05 2PL ±0.010 3PL ±0.005 4PL ±0.0005
FRACTION ± 1/16 ANGLE ± 1/2°

NOTICE

DEPT. NAME
DEPT. NO.
PROJECT NO.
APPROVED BY
DEPT.
DESIGNER D MUSTONEN
OPERATION ENG.
PROJECT ENG.
PLANT ENG.

OREMET-WAH CHANG
An Allegheny Teledyne Company
P.O. Box 580 - Albany, Oregon 97321

EXTRACTION WELL DETAILS
FOR EW-2 AND EW-3
(AS BUILT DRAWING)

DATE 1/10/2000	SCALE	PREVIOUS DWG# - - -
DRAWN BY DLK	DWG. NO. 153918W1	REV.
CHK'D BY DTM		

TARGET SHEET

Document ID PART OF 1537541

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1 of 1

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Seattle, WA 98101

ATI Metals
Feed Makeup Area GETS Modifications
March 30, 2018

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Portland, OR 97204
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info@gsiws.com www.gsiws.com